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Niagara Escarpment Legacy Project

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WESTERN NEW YORK LAND CONSERVANCY

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Acknowledgements

Years in the making, the Niagara Escarpment Legacy Project is the culmination of hundreds of hours of intense discussions, brainstorming sessions, committee meetings, and finally a grant award that transformed the Project from concept to reality.

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The ultimate success of this project will be judged by what happens next. Please help us transform this research into improvements in this incredibly unique resource in our Western New York community.

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List of Abbreviations and Acronyms

AOC	area of concern
BBA	(New York State) Breeding Bird Atlas
BBS	breeding bird surveys
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
E & E	Ecology and Environment, Inc.
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
GIS	geographic information system
gpm	gallons per minute
ISCMP	Invasive species control and management plans
Land Conservancy	Western New York Land Conservancy
NAACP	National Association for the Advancement of Colored People
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NRHP	National Register of Historic Places
NWI	National Wetland Inventory
NYNHP	New York Natural Heritage Program
NYSDEC	New York State Department of Environmental Conservation
NYSOPRHP	New York State Office of Parks, Recreation, and Historic Preservation
PCBs	polychlorinated biphenyls
PRISM	Partnership for Regional Invasive Species Management
Project	Niagara Escarpment Legacy Project
SAV	submerged aquatic vegetation
SGCN	(New York State) species of greatest conservation need
SPCC	spill prevention, control, and countermeasures

List of Abbreviations and Acronyms (cont.)

SUNY ESF	State University of New York College of Environmental Science and Forestry
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WNS	white-nose syndrome

Prologue

The Niagara Escarpment—
A Jewel in Our Midst

A Summary of the Project and an Invitation from the Executive Director of the Western New York Land Conservancy

Niagara Escarpment Legacy Project Mission Statement

"Identify the unique ecological and historical features of the Niagara Escarpment and create a conservation strategy that will conserve and restore land, improve public access, and provide public education about the escarpment."

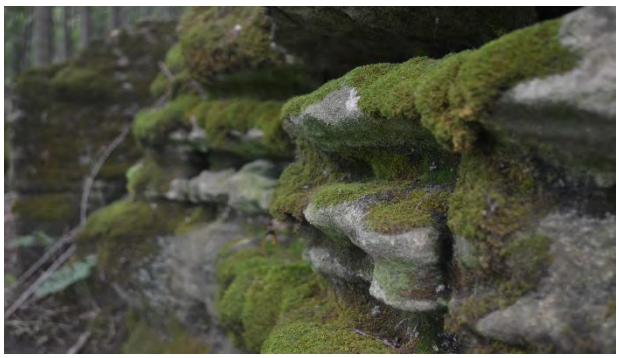
Introduction

The Niagara Escarpment, as it transects Niagara County along an east to west path on a narrow strip of dramatic, 150-foot-high rock outcroppings, is known worldwide as a geological marvel. But there is so much more to it than geology. In this report you will learn that the Niagara Escarpment is also a treasure trove of ecological diversity, a scenic wonder, and a living history exhibit—a jewel in our midst. The escarpment holds flora, fauna, fossils, soils, waterways, and wetlands in an astonishing variety for so small an area of land, existing in a host of ecological communities, some especially noteworthy such as the potential for oak openings, alvar shrubland, and alvar woodland communities. You will also find species that have been recognized by New York State and by scientists as threatened and of special concern.

Our Project will explain how, over the centuries, the Niagara Escarpment has played host to human activities from groups as varied as Native Americans, European settlers, armies, escaping African-American slaves, farmers, manufacturers, entrepreneurs, miners, and commercial shippers. Despite the constant and sometimes destructive activity of its human inhabitants and visitors, the escarpment has shown itself to be forgiving, resilient, and constantly awe-inspiring. However, this report will explain that the escarpment needs careful stewardship if it is to remain such a valuable and timeless resource. And you will be invited to join in this work.

Prologue (cont.)

The Niagara Escarpment Legacy Project (the Project) paints a detailed portrait of the escarpment from scientific and historical perspectives, using both quantitative and qualitative analysis, as it advocates for the escarpment. Field survey reports and supporting research have expanded the knowledge base about the Niagara County section of the escarpment and identified previously unrecorded ecological assets, while at the same time deepening relationships between municipal and community partners interested in the escarpment. The Project sets goals for the conservation, restoration, and future stewardship of this unique landscape, including the identification of specific properties that will be considered for future preservation, and then outlines strategies that stakeholders from the private and public sector can use to reach those goals.



Weathered, rocky outcroppings along the escarpment.

Niagara Escarpment Overview

The Niagara Escarpment in Niagara County is part of an international escarpment that stretches 750 miles from central New York, west across the Niagara River and Niagara Falls, northwest through Ontario, up the Bruce Peninsula and onto Manitoulin Island, into Michigan's Upper Peninsula, leveling out eventually in Wisconsin. The escarpment is the steep north face of a bedrock ridge whose sedimentary rock layers were formed from sediments deposited more than 400 million years ago when North American was closer to the equator and the escarpment region was covered by a shallow sea. The ridge we see today is the result of tectonic uplift, multiple glaciations, and millions of years of erosion. The climatic and geological features that define the ecology, history, and economy of this region, including the formation of the Niagara Gorge and Niagara Falls, have been influenced by the escarpment. The escarpment traps warmer air along the southern shore of Lake Ontario, creating unique microclimates that are ideal for fruit tree farms and vineyards, and the steep terrain, rock-strewn slopes, and deeply incised creek valleys of the escarpment itself create habitat types and plant and animal communities that include mature forests, savannahs, grassland habitats, vernal pools, talus caves, cool, moist glades, and transitional shrub habitats. The geology, fossil diversity, and ecology of the Niagara Escarpment have drawn the attention of the United Nations, which recognized the Canadian portion as a Biosphere Reserve in 1990.

Prologue (cont.)

Source: http://upload.wikimedia.org/wikipedia/commons/1/18/Niagara_Escarpment_map.png
The full extent of the escarpment is shown in red.

Project Overview

This Project, the first comprehensive study of the cultural history and ecological features of the Niagara Escarpment in New York, focuses on Niagara County specifically and was funded through the Niagara River Greenway Ecological Standing Committee. The Project is a cooperative venture led by the Western New York Land Conservancy (Land Conservancy), using the technical expertise of professional staff at Ecology and Environment, Inc. (E & E) and guidance from local stakeholders who represent landowners, area residents, governmental agencies, and environmental, historical, commercial, cultural, and tourism organizations. The Project identifies opportunities to preserve, restore, and enhance the escarpment's resources and provides conservation and restoration goals and strategies for long-term planning. The Project has received the endorsement of the Niagara Communities Comprehensive Plan 2030, prepared by Niagara County and whose authors issued this statement: "Support the Niagara Escarpment Legacy Project initiative of the Western New York Land Conservancy and other organizations to protect the ecological, open space, and scenic value of the Escarpment; encourage public acquisition and set-aside of undeveloped parcels through private donation or purchase, and investigate the potential of establishing public access trails and nature areas along the length of the Escarpment with linkages to other trail systems."

The Project included a preliminary desktop analysis of the land use and ecological and historical features along the escarpment, followed by comprehensive field surveys for a variety of ecological and geological features at 19 public and private sites within the Project Study Area. The Study Area included the geological boundary of the escarpment and a buffer zone of 1,000 feet to the north and 0.25 miles to the south. The buffer zone features soils that are closely associated with the ecological communities found on the escarpment (see Section 3.4.1). The 19 sites, totaling approximately 2,500 acres along the escarpment, were surveyed during the spring and summer of 2013. These sites included five public parks—Royalton Ravine Park, Lockport Nature Preserve, Bond Lake County Park, Rollin T. Grant Wilderness Gulf Park, and Earl W.

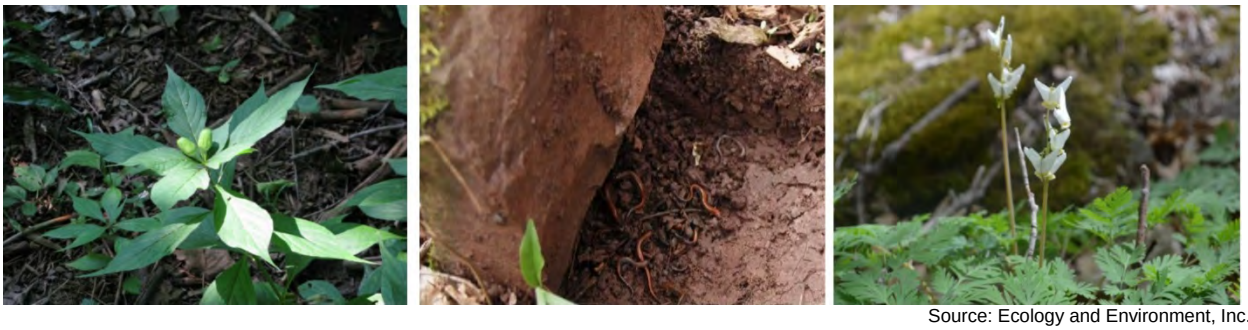
Prologue (cont.)

Brydges Artpark—24 private parcels (owned by 20 individual private landowners), and a portion of the Tuscarora Nation Territory. Survey data, an analysis of existing conditions, and meetings with stakeholders guided the development of a long-term conservation strategy for the Niagara County portion of the escarpment (described in Section 5 of this report).

Important Findings

In the body of the report are descriptions, quantification, and analysis of the various ecological and geological phenomena found along the escarpment: birds, amphibians and reptiles, bats, plants and trees, fossils, soils, and waterways. Among those are some significant findings. The Project identified three plants listed by New York State as threatened: the yellow giant hyssop (*Agastache nepetoides*); the big shellbark hickory (*Carya laciniosa*); and the smooth cliff brake (*Pellaea glabella*). Three bird species listed as of special concern by the state were found in field surveys: the Cooper's hawk (*Accipiter cooperii*), the vesper sparrow (*Poocetes grimineus*), and the grasshopper sparrow (*Ammodramus savannarum*). An amphibian found in the surveys, the blue-spotted salamander (*Ambystoma laterale)*, is also on the species of special concern list. Survey scientists found indicators of three ecological communities considered locally rare; the alvar shrubland, the alvar woodland community, and the oak openings community. Invasive plants were identified and are discussed in Section 3.3.

The report also describes and quantifies present day land uses on the escarpment: agriculture, mining, recreation and parks, private residences, commercial and industrial enterprises, and the Tuscarora Nation Territory. Areas of disturbance and contamination and the status of clean-up efforts are identified as well.



Source: Ecology and Environment, Inc.

From left to right: green violet, red-backed salamanders, and Dutchman's breeches.

The Project identifies historical resources and demonstrates how the escarpment mirrors the cultural history of the region, containing sites that are sacred to the Haudenosaunee Confederacy (known to the French as the Iroquois Confederacy and to the English as the League of Five Nations), way stations and safe houses used for the Underground Railroad, historical sites related to the building of the Erie Canal in the early and mid-19th century, and "witness trees" that are old enough to have stood as sentinels since the days when Lewiston and the Tuscarora Nation played vital roles in the War of 1812. As a heritage region of great significance, the Niagara

Source: Ecology and Environment, Inc.

One of the active vineyards near the escarpment.

Frontier in general, and the Niagara Escarpment in particular, retain many of the characteristics and vestiges of the past, forming viable educational, recreational, and tourism opportunities.

The National Register of Historic Places (NRHP) (see Table 2.1-1) lists 35 historic sites near the Niagara Escarpment. The historic structures located on these 35 sites are significant for many reasons: their architecture, their relationship to the War of 1812 and the Civil War, their Native American links, their role in the development of the Erie Canal, the part they played in the Underground Railroad, their importance in the region's industrial and commercial development, and their role in the women's suffrage movement.

Niagara Escarpment Conservation Goals and Strategies

Source: Western New York Land Conservancy

Stakeholders discuss the future of the escarpment with E & E staff

The results of this study demonstrate that there are significant ecological, cultural, and recreational resources along the Niagara Escarpment that should be protected and conserved for future generations. A coalition of regional stakeholders both public and private, Land Conservancy staff, E & E staff, and experts in many disciplines established four major goals for the Niagara Escarpment in Niagara County. The coalition offered strategies needed to reach those goals and identified potential problems that might be encountered (discussed further in Section 6). The purpose of these goals and conservation strategies is to help municipal leaders and local organizations make informed decisions about conserving and restoring the escarpment while improving public access to it and enhancing its economic impact on the region.

Goal 1: Conserve critical natural and cultural resources, areas of high biodiversity and special sensitivity, and areas important to ecological connectivity.

Strategy 1-1: Develop a local Niagara Escarpment friends group that will work to conserve the significant ecological and cultural resources of the escarpment.

Strategy 1-2: Identify additional environmentally sensitive areas.

Strategy 1-3: Improve stewardship of existing conserved areas.

Strategy 1-4: Conserve priority properties using a variety of voluntary mechanisms.

Source: Ecology and Environment, Inc.

Fossils found near Lockport.

Source: Ecology and Environment, Inc.

A field of white trillium.

Strategy 1-5: Work with municipalities to incorporate conservation of the escarpment into their land use planning.

Strategy 1-6: Work to obtain voluntary designations for historic resources when appropriate as well as an international, national, or statewide designation for the entire escarpment that recognizes its ecological and cultural values and that promotes better stewardship of its resources.

Goal 2: Restore ecologically significant areas.

Strategy 2-1: Identify ecologically significant areas in need of restoration.

Strategy 2-2: Identify ecologically significant areas that are contaminated and prioritize cleanup of these sites.

Strategy 2-3: Provide landowners with outreach materials that have information on the best management practices to use for restoring habitat, soils, and water quality and preventing the spread of invasive species.

Goal 3: Strengthen the regional economy.

Strategy 3-1: Coordinate with local, regional, and state tourism organizations to promote the Niagara Escarpment and develop a Niagara Escarpment brand.

Strategy 3-2: Work with local farmers and municipalities to preserve, expand, and promote existing agricultural enterprises along the escarpment.

Strategy 3-3*:* Collaborate with and provide information to the public and to elected officials on the economic benefits of open space.

Source: Western New York Land Conservancy

Hikers in search of wildflowers at the Niagara Escarpment Preserve on Leete Rd. in Lockport.

Goal 4: Provide the public with access to and more opportunities for recreation and education.

Strategy 4-1: Identify areas for new or enhanced access to existing public sites. This may include connecting previously unconnected trails or developing and then connecting new trails on abandoned railroad beds, utility corridors, or informal trails.

Strategy 4-2: Develop self-guided escarpment tours that include way-finding and interpretive signs.

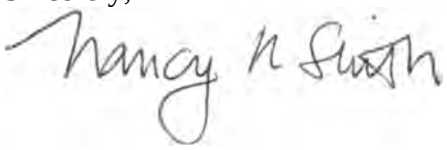
Strategy 4-3: Develop a public education program about the escarpment's geological, ecological, and historical significances.

Report Summary

Nine main sections and eight appendices make up the body of the Niagara Escarpment Legacy Project and offer in-depth information and analysis. Section 1 offers an overview of the Study—the rationale for undertaking the Study, it's funding, the Study framework, the Steering Committee and stakeholders, and locations to be studied. Section 2 presents the natural, cultural, and social history of the Niagara Escarpment and the surrounding area. Section 3 discusses the extensive field survey results of the ecological and geological makeup of the escarpment and gives an overview of commercial, agricultural, cultural and recreational activities in the area. In Section 4 there is a discussion of the results of the Study with conclusions that can be drawn from those results. Section 5 notes the benefits of conservation on the Niagara Escarpment. Section 6 has detailed strategies for reaching the goals enumerated in this Prologue. Section 7 is a brief epilogue, Section 8 lists the references to texts and research materials used in the study, and Section 9 provides a glossary of terms used throughout the report. The eight appendices provide more detailed information on topics discussed in this report.

Thank you for exploring the Niagara Escarpment with us, and please join us in conserving, preserving, and restoring this wonderful jewel in our midst.

Sincerely,



Nancy Smith
Executive Director, the Western New York Land Conservancy

Sunlight through trees onto escarpment outcrop, Cambria

Limestone hardbottom channel with flow in summer, Royalton Ravine Park, Royalton

1 The Niagara Escarpment Legacy Project

Niagara Escarpment Legacy Project Mission Statement

"Identify the unique ecological and historical features of the Niagara Escarpment and create a conservation strategy that will conserve and restore land, improve public access, and provide public education about the escarpment."

1.1 Project Overview — Study Rationale

The Niagara Escarpment is widely recognized as one of the world's unique natural landforms, one that is home to significant ecological communities and flora and fauna in a vast array. It is a ridge of rock 150-feet high that extends approximately 750 miles, beginning in the east in Western New York, forming the precipice that created Niagara Falls, and continuing through Ontario, Michigan, and Wisconsin (see Figure 1.1-1). The bedrock of the Niagara Escarpment formed more than 400 million years ago when the North American continent was closer to the equator. The bedrock formed because marine deposits of sand, clay, and mud, along with decayed tissues and skeletal remains of marine organisms, created layers of sedimentary rock of sandstone, limestone and shale, with a cap of hard dolomite rock. The escarpment was formed after tectonic activity tilted the bedrock, exposing it to erosion by water, weather, and glaciers. These geological activities occurred over millions of years, resulting in the erosion of the softer sandstone and shale rock, and leaving overhanging ledges of dolomite that occasionally collapsed. This sequential process of erosion and collapse, dominated by the resistant layers of dolomite rock, has caused the face of the escarpment to retreat many miles southward to the location where we see it today.

Approximately 12,000 years ago, the retreat of the most recent glacier left behind numerous lakes and streams, including the Niagara River and Lake Tonawanda, a shallow lake that was perched atop the Niagara Escarpment and the Niagara River. The glacial retreat set the stage for the creation of Niagara Falls and the Niagara Gorge that we presently enjoy (see Section 3.4). The resulting deeply incised creek valleys, steep terrain, and rock-strewn slopes of the escarpment also created habitat types and plant and animal communities that include mature forests, savannahs, grassland habitats, vernal pools, talus caves, cool, moist glades, and transitional shrub habitats. Today's escarpment traps warmer air along

the southern shore of Lake Ontario, which creates unique microclimates that are ideal for fruit tree farms and vineyards.

Source: http://upload.wikimedia.org/wikipedia/commons/1/18/Niagara_Escarpment_map.png

Figure 1.1-1 Niagara Escarpment

The Niagara Escarpment has also significantly influenced the human history and culture of Niagara County and the surrounding region. The area evolved from the home of Native Americans to include British colonists, newly independent Americans, canal builders, fugitive slaves, entrepreneurs, farmers, limestone miners, industrialists, and eventually the diverse population that lives here today. A more comprehensive history is presented in Section 2 of this report.

The geology, fossil diversity, and ecology of the Niagara Escarpment have drawn the attention of the United Nations, which recognized the Canadian portion as a Biosphere Reserve in 1990. In response to international recognition, Ontario has developed a Niagara Escarpment Plan, updated in 2012, for land use and protection for their portion of the escarpment. Additional major protection initiatives are taking place for the portion of the escarpment in Wisconsin.

The Niagara Escarpment Legacy Project (Project) is the first comprehensive study of the Niagara County portion of the Niagara Escarpment—its natural features and its cultural, social, and natural history. It is also the first study that includes a site-based ecological inventory of the area. The Project directly responds to the many governmental agencies and environmental organizations that have called for protection and conservation of the escarpment. Some examples include the following:

- The Niagara River Greenway Plan identified protection of the Niagara Escarpment as a priority conservation project, specifically focused on protecting the biodiversity of significant habitats along the length of the Niagara Escarpment in Niagara County. Preservation goals are focused on forested tracts, protection of shellbark hickory wetland forests, abandoned farmland, and wetland and floodplain habitats.
- The New York State Department of Environmental Conservation (NYSDEC) Comprehensive Wildlife Conservation Strategy for New York recommends that preservation of key parcels along the Niagara Escarpment should be a prime objective in the development of the Niagara Communities Comprehensive Plan. NYSDEC also indicated that the unique features along the escarpment that should be considered for conservation were rocky, wooded forest habitats; vernal pools at the escarpment base; and habitat for a variety of important wetland flora and fauna (NYSDEC 2005). The New York State Open Space Conservation Plan of 2009, in the section entitled "Great Lakes Shorelines & Niagara River," states that "the lake plain and escarpment, especially where the escarpment is relatively close to the lake, define important avian and bat migratory flyways, providing important resting and feeding areas during migratory periods and critical airspace for migrating birds and bats. The Lake Erie and Niagara Escarpments are noted geographical features that provide a diversity of ecologically significant habitats along their shore, as well as important historic, cultural and scenic assets."
- The Niagara Communities Comprehensive Plan 2030 identifies the management of the Niagara Escarpment as a priority issue for the county. The Plan categorized the Niagara Escarpment as an asset and opportunity for the county and the preservation and control of development along the escarpment as a goal through 2030. The Plan states that "concerted efforts are under way to protect and preserve the Niagara Escarpment and its valuable ecosystems consisting of unique floral and faunal habitats. The Escarpment contributes significantly to the visual character of many communities in Niagara County, and to the region's economy as well" (Niagara County 2009).
- The Erie-Niagara Framework for Regional Growth Plan, completed in October 2006, recommends the enactment of a Conservation Heritage Assets Overlay for future land use planning for the Niagara Escarpment. Such an overlay is intended to conserve areas with unique concentrations of natural, recreational, scenic, and cultural resources. An example of an existing overlay district is in the Town of Cambria, where an Escarpment District was adopted in 1973 that includes the majority of the segment of the Niagara Escarpment within the town. Article VIII of the Town of Cambria Zoning Ordinance states that the purpose of the Escarpment District is "to preserve the natural beauty, protect wildlife, minimize pollution and to ensure the community and landowners that this land be properly developed."

The goal of this Project is to establish the significance of the escarpment with quantitative data and historical research and then to pinpoint opportunities to

preserve, restore, and enhance these resources based on the findings of the study, and to provide a set of conservation goals and strategies for long-term planning.

1.2 Project Funding

The Project was funded by a grant from the Niagara River Greenway Ecological Standing Committee and was conducted as a cooperative venture led by the Western New York Land Conservancy (Land Conservancy), with guidance from local stakeholders, and with technical and professional expertise from Ecology and Environment, Inc. (E & E). The Project was designed to complement the Niagara River Greenway Commission's planning initiatives for the Niagara River corridor and to be consistent with the goals of the Niagara River Greenway Plan. The Niagara Escarpment was identified in the Niagara River Greenway Plan as a priority area for acquisition of land and conservation easements. Land conservation is the core mission of the Land Conservancy, which has identified conservation of the Niagara Escarpment as a top priority for many years. In 2011, the Land Conservancy acquired its first parcel of land in the Niagara Escarpment Preserve. On Leete Road, in the Town of Lockport, this 36-acre parcel includes 10 acres of restored grassland habitat and 21 acres of mature hardwood forest, among other habitats, and protects unique ecological communities along 1,000 linear feet of the escarpment.

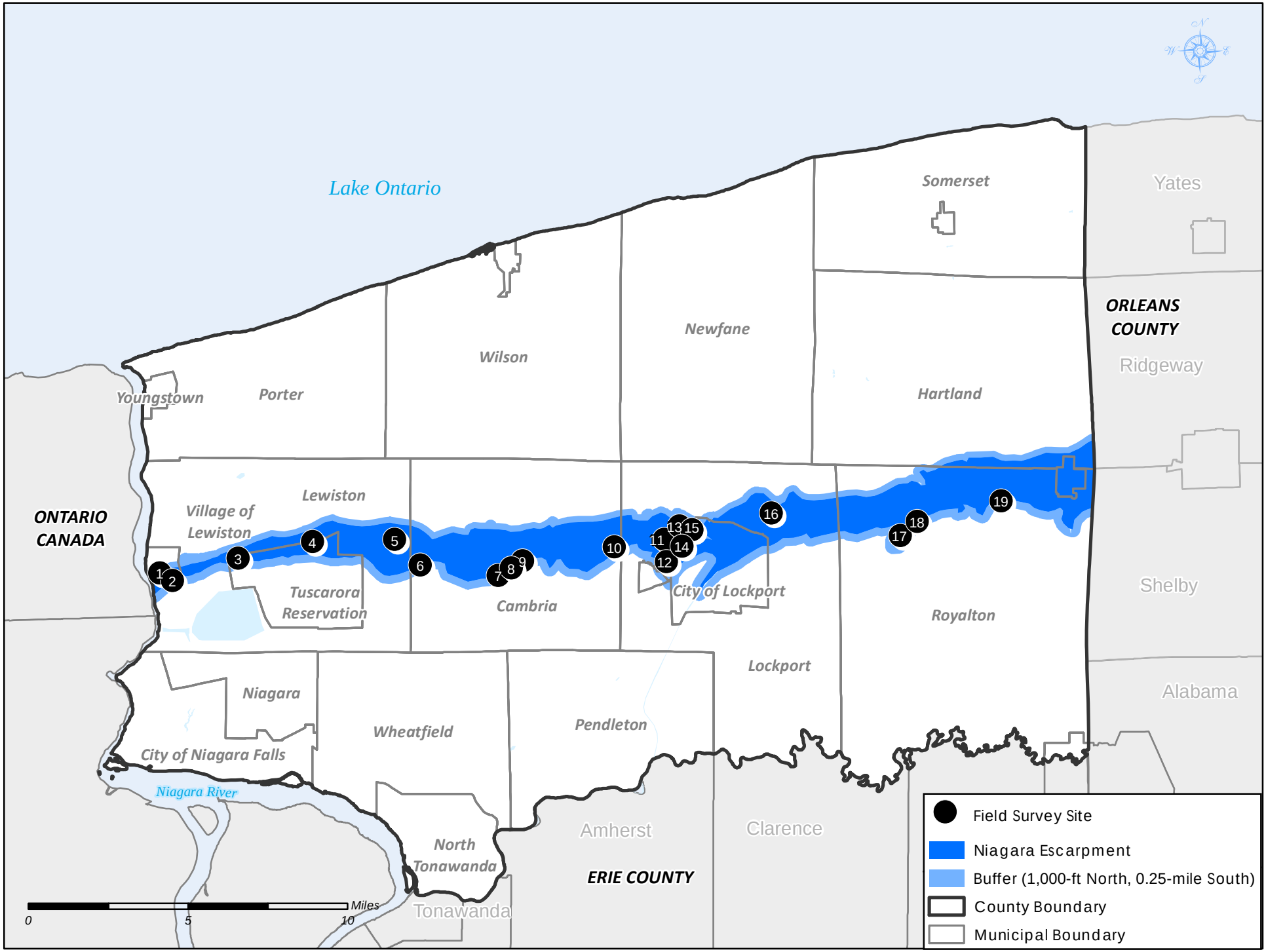
1.3 Laying the Groundwork for the Study

The Project was initiated with a desktop analysis of the land use and ecological features along the escarpment. The Study Area included the geological boundary of the escarpment and a buffer zone of 1,000 feet to the north and 0.25 miles to the south. The buffer zone includes soils that are very closely associated with the ecological communities found on the escarpment (see Section 3.5.1). Figure 1.1-2 shows the general locations of the field surveys in the Study Area.

Although the westernmost portion of the Study Area includes a small portion of the Niagara Gorge, the gorge was not included as part of the studies for this Project. The Niagara Gorge and the ecological gorge communities from Niagara Falls to Lewiston have been the subject of many significant ecological and cultural studies by the Niagara River Greenway Commission and the New York State Parks Department. These ecological communities within the gorge are significantly different from the ecological communities and wildlife (migratory birds and fish, in particular) associated with the Niagara Escarpment.

Baseline mapping of the escarpment in Niagara County used publicly and commercially available geographic information system (GIS) data. Information was gathered for this baseline mapping from Niagara County government parcel data, Buffalo Niagara Riverkeeper habitat inventories, NYSDEC, the U.S. Fish and Wildlife Service (USFWS), New York State Museum geological surveys, cultural resources from the New York State Office of Parks, Recreation, and Historic Preservation (NYSOPRHP), and land cover data from the U.S. Geological Survey (USGS) National Gap Analysis Program. Complete baseline mapping for the Study Area is located in Appendix A.

Figure 1.1-2 Niagara Escarpment Study Area



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1.4 Stakeholder Engagement and Project Steering Committee

Before the Project could get under way, it was important to have the support of stakeholders: landowners, local residents, community and service organizations, municipal leaders, and all parties interested in the conservation of this precious resource.

A key part of the Niagara Escarpment Legacy Project, then, was to establish a Steering Committee and stakeholder group to garner additional support and input on the Project. These groups included Land Conservancy staff, E & E staff, municipal leaders and representatives of not-for-profit organizations, and others with an interest in and knowledge of the Niagara County portion of the escarpment.

Steering Committee and Stakeholders

One Steering Committee meeting and two additional stakeholder meetings were held over the course of the one-year study. The Steering Committee consisted of a group of local advocates who helped to define the Study Area, determining what types of field surveys should be conducted, where and when they should occur, and identifying data sources, existing studies, and additional stakeholders with an interest in the Project. A larger stakeholder group, which included the members of the Steering Committee, was convened to solicit additional information regarding potential locations for field surveys and input on the components of a long-term conservation strategy for future use of the Niagara Escarpment. Summaries of each of these stakeholder meetings are provided in Appendix F.

Source: Western New York Land Conservancy

Stakeholder Meeting on September 25, 2013 at Stella Niagara.

Municipal Leaders

In order to bolster support for the Project and gather information specific to each municipality, early steps of the Project included meetings with leaders in municipalities along the escarpment to discuss their areas of interest and concerns.

Additionally, municipal leaders provided suggestions for potential field survey locations, areas of great scenic value, and historical and cultural resources within their municipalities.

Landowners

Public and private landowner participation was essential to the success of the Project. The Land Conservancy contacted more than 55 private landowners with property located on or next to the Niagara Escarpment and 20 agreed to participate in the Project's field surveys.

Steering Committee

- U.S. Fish and Wildlife Service
- NYSDEC, Region 9
- NYS Office of Parks, Recreation and Historic Preservation
- Niagara Peninsula Conservation Authority
- The Nature Conservancy
- Haudenosaunee Environmental Task Force
- Freedom Run Winery
- Niagara County Soil and Water Conservation District
- Buffalo Niagara Riverkeeper
- Niagara County Cornell Cooperative Extension
- Niagara Frontier Botanical Society
- Buffalo Audubon Society
- Western New York Land Conservancy
- Ecology and Environment, Inc.

Additional Stakeholders

- (USDA) National Resource Conservation Service
- NY Farm Bureau
- New York Natural Heritage Program (of State University of New York College of Environmental Science and Forestry)
- History Center of Niagara
- Bond Lake Environmental Beautification Committee
- The Historical Association of Lewiston
- Office of Congressman Brian Higgins
- Niagara County Historical Society
- Niagara County Sportsmen's Association
- Town of Lockport Historian
- Residents/Landowners
- Office of Senator George D. Maziarz

Municipalities

- Village of Lewiston
- Town of Lockport
- Town of Cambria
- Town of Royalton
- Town of Lewiston
- City of Lockport
- Town of Hartland
- Village of Middleport

1.5 Field Survey Methodology, Locations, and Areas of Study

Field survey locations were based on ecological features identified on the baseline mapping and on input from the Steering Committee and other stakeholders. Field survey pre-planning focused on identifying areas along the escarpment where more detailed field surveys would best characterize the escarpment. Selection of field survey sites (see Table 1.1-1 for a complete listing) was based on a variety of factors:

- Evaluation of baseline atlas mapping of the following features:
  - Wetlands
  - Vernal pools
  - Contiguous mature forest
  - Potential for threatened and endangered species
  - Existing land use
  - Proximity to areas such as public parks and other areas where land is already conserved
  - Proximity to areas that may be subject to encroachment by nearby development
- Feedback from Steering Committee members and other stakeholders on unique natural habitats or features
- Landowner approval.

To focus the types of field surveys that would be conducted, desktop mapping was used to evaluate the habitats expected at each of the field sites. Field surveys were completed within appropriate survey windows in the spring and summer of 2013 and included the following subjects:

- Herpetological species (reptiles and amphibians [only at sites with known water features])
- Breeding birds
- Special habitat (wetlands, waterbodies, vernal pools)
- Vegetation
- Invasive species
- Threatened and endangered species
- Geology.

The field surveys to assess general habitat characterization were conducted at each of the sites between May and August 2013. Targeted sites with known habitat were also surveyed for amphibians in late April and early May and for breeding birds in early June. Table 1.1-1 identifies the general location and description of each site and the surveys conducted.

A description of field survey methodology is located in Appendix B. The results of these field surveys have been summarized throughout this report. The field results for each site (Appendix C) can be obtained by contacting the Western New York Land Conservancy. The complete botanical atlas and breeding bird atlas are provided in Appendices D and E, respectively.

Table 1.1-1 Niagara Escarpment Field Survey Sites

Site No.	Town/Village	Private/Public Parcel	Surveys Conducted	Site Description
1	Village of Lewiston	Public – Artpark: Scovell's Knoll	Plant 2; BB	Former location of the historic Scovell Mansion adjacent to Artpark. A prehistoric burial mound is also present at this site in the southwest corner. A spring/seep or slope drainage combines with an historical stream course with an outfall into the Niagara River to the west.
2	Village of Lewiston	Public utility right-of-way	Plant 2	Historic railroad corridor now maintained as a right-of-way for utilities.
3	Tuscarora Nation Territory	Private	Plant 1; BB	Relatively undisturbed land comprises site 3, located on the Tuscarora Nation Territory. Prehistoric and pre-settlement travel routes are within this site and historic features and artifacts have been documented.
4	Town of Lewiston	Private	Plant 1, 2	Site 4 consists of active vineyards and agriculture fields, residential use, upland forest habitat, and a stream-ravine corridor. This site is located on the northern border of the Tuscarora Nation Territory.
5	Town of Lewiston	Private	Plant 1, 2; BB; A	Consists of a privately owned parcel occupied by a residence, cultivated grape vineyards, and northern hardwood forests. The escarpment gives way to large boulders and caves within the forested areas of the site.
6	Town of Cambria	Private	Plant 1, 2; BB	Consists mostly of early growth to mid-aged forests dominated by sugar maple, black cherry, honeysuckle, and gray dogwoods. Many invasive species, such as honeysuckle and multiflora rose, were present at this site.
7	Town of Cambria	Private	Plant 1, 2; BB	Consists of a vineyard, forested areas, and a pond surrounded by maintained lawns. A stream, with several waterfalls, runs through the property in a valley adjacent to the escarpment.
8	Town of Cambria	Private	Plant 1, 2; BB	Operational Girl Scout camp encompassing forested areas as well as cabins and shelters surrounded by maintained lawns. A pond and a stream are also located on this property.

Table 1.1-1 Niagara Escarpment Field Survey Sites

Site No.	Town/Village	Private/Public Parcel	Surveys Conducted	Site Description
9	Town of Cambria	Private	Plant 1, 2; BB	Consists of both forested land throughout and cultivated fields (above the escarpment). The escarpment is relatively steep at this site. An ephemeral channel crosses this site at the top of the escarpment, proceeding over the edge and creating a waterfall.
10	Town of Cambria	Private	Plant 1, 2; BB; A	Consists of a winery facility, vineyards, and additional mixed variety of row crops. The vineyard and cultivated land covers the majority of this site.
11	Town of Lockport	Private	Plant 1, 2; BB; A	Consists primarily of deciduous forest, located along the top of the escarpment, with a dense understory and rocky, relatively flat topography. Rocky depressions along the escarpment allow for standing water.
12	City of Lockport	Private	Plant 1; BB	Contains an open field, northern hardwoods, stream, pond, and a successional northern hardwood forest. This site is located near an industrial facility, and the water resources on this parcel were noticeably contaminated.
13	Town of Lockport	Private	Plant 1, 2; BB; A	Contains suburban residential properties and associated maintained lawns; forests and hayfields; successional shrub, early woodland forest, and a meadow with scattered shrubs and trees. This property is crossed by three small tributaries that converge near the base of the escarpment.
14	City of Lockport	Public – Rollin T. Grant Gulf Wilderness Park	Plant 1, 2; BB	Public park located in City of Lockport.
15	Town of Lockport	Private	Plant 1, 2; BB; A	Has several different land features including wetlands, bottomland, floodplain, and an excavated pond. The site is surrounded by residences, an industrial facility, forest and shrubland, and a municipal compost facility/sewage treatment facility. Sandstone mining during construction of the Erie Canal has also historically occurred in this area. Eighteen Mile Creek runs through this site.

Table 1.1-1 Niagara Escarpment Field Survey Sites

Site No.	Town/Village	Private/Public Parcel	Surveys Conducted	Site Description
16	Town of Lockport	Public – Lockport Nature Trail	Plant 1, 2; BB	A recreational park consisting of both forested land and an open field that is completely surrounded by forest. An intermittent stream and waterfall flows through the eastern portion of this site.
17	Town of Royalton	Public – Royalton Ravine Park	Plant 1, 2; BB	Parkland with maintained lawns nearest the road, transitioning to forest in the western portion of the site. A branch of Eighteen Mile Creek and associated tributaries also flows through the park.
18	Town of Royalton	Private	Plant 1, 2; BB; A	Site 18 is entirely forested and surrounded by residences on all sides. A stream and tributary run through this site. Exposed escarpment is not present on this site.
19	Town of Royalton	Private	Plant 1, 2; BB	Site 19 is heavily disturbed and located next to a transmission line right-of-way, roads, and residences. Overall, this site is severely disturbed and has limited ecological value.

Notes:
Field Surveys Conducted:
Plant 1: Early ephemeral plant survey (conducted in April/May)
Plant 2: Summer plant survey (conducted in July/August)
BB: Breeding bird survey (conducted in June)
A: Amphibian survey (conducted in April/May)

Prickly gooseberry (*Rybes cynosbati*), Lewiston

Wood frog (*Rana sylvatica*) in camouflage, Lockport

Grape harvest in Niagara County with view of Niagara Escarpment, Lewiston

Seasonal flow seep from escarpment rim, Cambria

2 A Brief History of the People of the Niagara Escarpment

The ridge of rock that forms the Niagara Escarpment transects Niagara County from east to west. The escarpment emerges from the Niagara River on the American side in the Village and the Town of Lewiston in the west, crosses through the towns of Cambria and Lockport, the City of Lockport, and the towns of Royalton and Hartland to the east. Because of its geographic span, this ridge has served as a natural passageway for both wildlife and human populations for generations, providing the setting for a centuries-long history so rich and relevant that it demands to be kept in the public consciousness. Understanding the history of the escarpment in Niagara County is essential to the analysis of the current geologic and ecological features along the escarpment. The connection between landscape, natural history, and human history cannot be overemphasized. What is presented here is meant to highlight these connections and further foster support for the conservation goals and strategies established as part of this Project, which are discussed in detail in Section 6.

2.1 Cultural and Historic Places

Thirty-five historic sites in the vicinity of the Niagara Escarpment in Niagara County are listed on the NRHP (see Table 2.1-1). The historic structures that are on these 35 sites are significant for many reasons: their architecture, the link they provide to Native Americans and the earliest settlers of the region, their relationship to the War of 1812 and the Civil War, their role in the construction of the Erie Canal and the development of local industry and commerce, and the part they played in issues of social justice like the Underground Railroad, abolition, and women's suffrage.

Table 2.1-1 National Register of Historic Places in the Vicinity of the Niagara Escarpment

National Register of Historic Places Site	Municipality	Historical Context	Period of Significance
Amzi Bradley House	Hartland	Architecture	1839-1900
Bacon-Merchant-Moss House	Lockport	Architecture, Underground Railroad	1832-1951

Table 2.1-1 National Register of Historic Places in the Vicinity of the Niagara Escarpment

National Register of Historic Places Site	Municipality	Historical Context	Period of Significance
Benjamin C. Moore Mill (Lockport City Hall)	Lockport	Commerce, Engineering, Industry, Architecture, and Political.	19th Century
Chase/Crowley/Keep House	Lockport	Architecture, Women's Suffrage	1856-1905
Chase/Hubbard/Williams House	Lockport	Architecture	1870-1900
Cold Springs Cemetery	Lockport	Cemetery	1815
Colonel William M. and Nancy Ralston Bond House	Lockport	Architecture	1823
Conkey House	Lockport	Architecture, Erie Canal, Earliest settlers	1984
Constant Riley W. Bixby House	Hartland	Agricultural	1845-1900
Day Peckinpaugh (Canal Motorship)	Lockport	WWII, Erie Canal system	1921-1958
District No. 10 Schoolhouse	Hartland	Architecture, Education	1835-1840
Dole House	Lockport	Architecture	1840-1932
Frontier House	Lewiston	Stone tavern, War of 1812	1813
Gibbs House	Lockport	Architecture	1850-1989
Harrington Cobblestone Farmhouse	Hartland	Architecture	1843-1930
Hopkins House	Lockport	Architecture	1833-1900
House at 8 Berkley Drive	Lockport	Architecture	1957
Lewiston Mound	Lewiston	Native American	Prehistoric
Lewiston Portage Landing Site	Lewiston	Native American	Prehistoric
Lockport Industrial District	Lockport	Industrial development	19th and 20th Century
Lower Niagara River Spear Fishing Dock Historic District	Lewiston	Native American	Prehistoric
Lowertown Historic District	Lockport	Historic District	19th Century
Maloney House	Lockport	Architecture	1858-1922
Nathan Comstock House	Lockport	Architecture, Founders of Lockport	1823-1907
Niagara County Courthouse	Lockport	Government, Architecture	1857-1917
Peter D. Walter House	Lockport	Architecture	1858-1957
Philo Newton House	Hartland	Architecture	1835-1840
Stickney House	Lockport	Architecture, Abolition, Civil War	1850-1881
Thomas Oliver House	Lockport	Architecture	1891

Table 2.1-1 National Register of Historic Places in the Vicinity of the Niagara Escarpment

National Register of Historic Places Site	Municipality	Historical Context	Period of Significance
Union Station	Lockport	Architecture, Commercial importance	1889
United States Post Office-Lockport	Lockport	Architecture	1902
United States Post Office-Middleport	Middleport	Architecture, Great Depression	1939-1944
Watson House	Lockport	Architecture	1854-1943
White/Pound House	Lockport	Architecture	1835-1880
William Taylor House	Middleport	Architecture	Late 19th Century

Source: NPS Digital Library 2013

2.2 Native American Histories

The history of human beings on the Niagara Escarpment began long before the first Europeans came to the area, as far back as 8,000 years ago. Knowledge of ancient human activity is based on artifacts found throughout the region, while oral histories passed down through the generations help tell the stories of more recent times. The long, rich history of indigenous peoples of the region and the Haudenosaunee Confederacy has been, and continues to be, the subject of much study. Many books, articles, and museum exhibits are available to help 21st century citizens appreciate these inhabitants. What follows in this section of the Niagara Escarpment Legacy Project is a very brief survey of Native American activity on or near the escarpment. For a more comprehensive look at the Haudenosaunee Confederacy, visit www.haudenosauneeconfederacy.com.

2.2.1 The Haudenosaunee Confederacy

Called the Iroquois Confederacy by the French and the League of Five Nations by the English, the confederacy is more properly called the Haudenosaunee Confederacy, or "People of the Longhouse." The Haudenosaunee Confederacy, located in the northeastern United States and Canada, consisted of six nations, the Mohawk, Oneida, Onondaga, Cayuga, Seneca, and Tuscarora Nations. The confederacy, formed before the arrival of Europeans, was founded on the "Great Law of Peace," the code of democratic self-governing principles that guide the six nations to this day.

The story of the Great Law of Peace involves Deganawida, from the Mohawk tribe, and Jikonsahseh, a Seneca woman. In the 13th or 14th century, when the tribes were engaged in an undeclared war, Deganawida came to the Neuter Nation to spread his message that "the belief in rational thought is to be found in the power to create peace" (Wooster 2009). Even though Jikonsahseh had been trading information to both sides of the conflict and fanning the flames of war, Deganawida succeeded in convincing her of the wisdom of his plan. When the

Great Law of Peace came to the tribes, the two became known as the Peacemaker and the Peace Queen.

Fort Kienuka

Fort Kienuka, an ancient rock citadel, was built by the Senecas and Squawkihaw (and inhabited by the latter) on the Niagara Escarpment more than 1,000 years ago.

Fort Kienuka was known as a sacred place of peace, and bloodshed was forbidden within its walls. It was also against the law of the Iroquois Confederacy to murder anyone after leaving the fort without the fort queen's consent. The fort queen was in charge of keeping the peace in the region, and always had a "kettle of hominy" ready to feed the fugitives visiting the fort, irrespective of nationality. Upon arriving at the fort, the queen would bring visiting fugitives into one side of a room divided by a deer skin curtain. When the fugitives' pursuer arrived, she would bring them to the other side of the curtain, providing both parties with food. The queen would then draw the curtain to reveal they had been sharing a meal together and both sides would leave the fort in peace.

Despite these peacekeeping efforts, resentment grew between the Squawkihaw and the Senecas over competition in tribal contests. Jealous Squawkihaws pleaded with the queen to have the Senecas attacked by a neighboring tribe, while they sought refuge from the Massasaukas within the fort. The queen authorized this bloodshed on sacred ground, despite its breach of fort law. Fearing retaliation, the Squawkihaws were forced to initiate attacks on the Senecas, resulting in the eventual absorption of the Squawkihaws by the Senecas.

The fort was abandoned as a place of refuge, and according to Seneca tradition it was 600 years before another queen was elected. The tradition of peace at Fort Kienuka on the Niagara Escarpment has carried forward to future generations that occupied it.

2.2.2 Tuscarora Nation

The Tuscaroras represent the Sixth Nation of the Haudenosaunee Confederacy. In the pre-contact era, the Tuscaroras were located in the Niagara region but migrated to the mid-Atlantic region in what is now North Carolina. During the early 18th century in North Carolina, the Tuscaroras were defeated by the new European settlers in the Tuscarora War and, as a result, had to migrate north in search of new land. They arrived in central New York in Oneida territory and were welcomed by the Oneida tribe. By the late 1700s the Senecas had given the Tuscaroras land on the Niagara Escarpment east of Lewiston, and the tribe returned to its former homeland, where they remain today. In 1803, the U.S. government purchased land to complete the 6,247-acre reserve. The Tuscaroras were allies of the American Continental cause during the American Revolution and the War of 1812.

The Tuscarora Nation Territory currently consists of about 1,300 people on 9.3 square miles of land along the Niagara Escarpment just east of the Village of Lewiston (U.S. Census Bureau 2010). In 1957, the U.S. Supreme Court decided that the Federal Power Commission could condemn 550 acres of the reserve for the construction of the Niagara Power Project. Despite significant changes in their surroundings, they still hold close many of their traditions and abide by the laws of the Haudenosaunee.

2.2.3 Neuter Nation

The original tribal lands of the Neuter Nation were along the northern shore of Lake Erie and east of the Niagara River. The Neuter village of *On-gui-aaha-a*, meaning "neck," sat at the foot of the Niagara Escarpment at what is the present Village of Lewiston and likely encompassed Fort Kienuka. The Neuter Nation was known to occupy this area in the early 1600s, at which time it was a well-established tribe. The Neuters reportedly gave the name to the Niagara River because the French version of *On-gui-aaha-a* was *Nyah'-ga-rah* (Wooster 2009).

The Neuters' name came from their position of neutral territory between the Iroquois to the east and the Hurons to the west. The Iroquois and Huron were bitter enemies, but when they met on the Neuters' land, they met in peace (Horton et al. 1947). Although these tribes were at peace with the Neuters around the time that the French first encountered them in the early 1600s, this was not always the case.

The Neuters held burial ceremonies for their dead every 10 years. A mound located near the Kienuka fort, examined in the early 1900s, contained artifacts such as fragments of French pottery, dating the mound back to around 1640. This mound was likely one of the last 10-year burials by the Neuters prior to their absorption by the Senecas in 1653 (Lewis 1968). Neuter artifacts and other burial mounds have been identified throughout Niagara County, including in Cambria and Gasport on the Niagara Escarpment and on Tonawanda Island (Lewis 1959).

2.2.4 Joseph Brant

One of Lewiston's most famous residents was Joseph Brant. Brant, a member of the Mohawk Nation, was influential during the American Revolution and counted as his acquaintances both George Washington and King George. Brant lived in Lewiston from 1779 to 1785 on a 50-acre farm on the southeast corner of Ridge and Creek Roads. Behind his home was a fresh water spring that still exists. The 2-foot by 30-foot piece of land, which has been protected in perpetuity to protect this spring, is called Brant's Spring Park. The park is difficult to access and is believed to be one of the "world's smallest public parks" (Lowery 1963).

2.3 War of 1812

The 32-month-long War of 1812, pitting the upstart nation, the United States, against the vast British Empire and their Indian allies from the Mohawk tribe, was fought over issues that had simmered between the two countries since the Revolutionary War: trade and tariffs, impressment of American merchant sailors

into the British Royal Navy, and the plans by the United States to annex portions of Canada. The war was fought on three fronts: the Atlantic Coast, the American South and Gulf Coast, and the American-Canadian border. Lewiston became a focal point in the war because of its strategic position on the escarpment halfway between Lake Ontario and Lake Erie. In 1764, Captain John Montresor had devised an ingenious tramway called "the Cradles" to haul goods up and down the escarpment, solidifying Lewiston's position as a shipping hub in the late 18th and early 19th centuries. While the tramway's usefulness had waned by the opening of the war, Lewiston remained a critical battlefront.

Source: Niagara County Historical Society

Captain Montresor's Tramway lifted goods from the Niagara River up the Niagara Escarpment for travel around Niagara Falls from 1764 through the early 19th century.

Battle of Queenston Heights

Fought on October 13, 1813, in Lewiston, New York, the Battle of Queenston Heights was the first major battle of the War of 1812. This battle was an attempt by the United States to gain control of Fort George in Newark (present day Niagara-on-the-Lake) on the Canadian side of the Niagara River, as well as the rest of Canada. The U.S. lost this battle in large part because the local militia refused to cross into Canada because they did not consider it part of their mission to invade another country.

Source: Great Lakes Seaway Trail

Battle of Queenston Heights plaque at Lewiston Landing

Tuscarora Heroes

In early December 1813, American General McClure ordered the burning of Newark (Niagara-on-the-Lake) and Fort George. The residents had evacuated before the invasion, but they were left homeless in the cold winter. British-Canadian forces retaliated by capturing Fort Niagara at the mouth of the Niagara River in the middle of the night—without a battle—and subsequently invading and burning the Village of Lewiston, five miles to the south.

On December 19, 1813, the British-Canadians, along with their allies the Mohawks, invaded Lewiston. The Lewiston residents were poorly defended and their only hope for survival was to flee via Ridge Road. Residents of the nearby Tuscarora Nation heard the attack and proceeded to help their Lewiston neighbors by creating a barrier between them and their invaders. The Tuscaroras created a diversion for the attacking forces by blowing horns at the top of the Niagara Escarpment that generated enough noise to convince the invaders that they were greater in number than they actually were. Although they were actually outnumbered 30 to 1, the Tuscaroras succeeded in confusing the opposition, giving many Lewistonians time to escape.

The entire Village of Lewiston was destroyed during this retaliation, and while only 12 people were confirmed killed, many victims were thrown into burning buildings during the massacre, making an accurate body count impossible at the time. Unfortunately, the Tuscarora Village was also burned, but their bravery helped save many lives.

Source: Buffalo News.

Tuscarora Heroes Monument, dedicated December 19, 2013, Lewiston NY.

Tuscarora Heroes Monument

In an effort to show its gratitude to the Tuscarora people for their heroic acts to save the citizens of Lewiston 200 years ago, the Historical Association of Lewiston commissioned a monument that sits today at Portage Road and Center Street in the Village of Lewiston. In a ceremony that took place on December 19, 2013, the 200th anniversary of the Tuscarora's act of heroism, the monument, sculpted in bronze by Lewiston's Susan Geissler and depicting two Tuscarora men helping a Lewiston woman and her infant escape the British, was dedicated and a re-enactment of the rescue was performed. Six northern white pines, the sacred tree of the Iroquois, were planted around the monument, representing each of the six nations of the Iroquois Confederacy. The Tuscarora Heroes Monument is the largest War of 1812 monument in the United States.

> *"May our chain of friendship be brighter and brighter as time rolls on."*
> – Chief Elias Johnson 1881 in reference to the Tuscarora Heroes

Source: Ecology and Environment, Inc.

"The Hanging Tree" witness tree, at Onondaga Street and North Third Street, Village of Lewiston, estimated at 295 years old. The tree was likely used to carry out corporal punishment in the 19th century.

Source: Ecology and Environment, Inc.

White oak (*Quercus alba*) "Tryon" Witness Tree. Located on Lower River Road, near the existing location of Josiah Tryon's home, and estimated to be approximately 320 years old.

Witness Trees

The Historical Association of Lewiston initiated a project to survey the Town and Village of Lewiston for trees that are more than 200 years old. These trees have "witnessed" Lewiston's most historic times, from the War of 1812 to the present day. The survey route starts where the British landed in northern Lewiston at what is now the Stella Niagara Education Park and continues down Ridge Road to the Tuscarora Nation Territory east of Lewiston. Approximately 40 trees have been identified as more than 200 years old. The majority of these trees are white oaks (*Quercus alba)*, a species that can live up to 600 years under favorable conditions. Horse chestnuts (*Aesculus hippocastanum)*, sycamores (*Platanus occidentalis*), and hickories (*Carya* spp.) are among the Witness Trees, as well. These trees are considered "wolf trees," an old foresters' term for trees that have wide-spreading crowns that crowd out smaller trees and like a wolf, prey on the weak.

2.4 Erie Canal

Construction of the 363-mile-long Erie Canal that connects Lake Erie with the Hudson River began in 1817 and was completed in 1825. The canal was a major engineering challenge, and, ultimately, a major success. In addition to 18 aqueducts and nearly 300 bridges, it consisted of 83 locks built to transcend the 568-foot vertical rise from the Hudson River to Lake Erie. The canal was dug mostly by hand, but over the eight years of construction many tools were developed, including hand drills, blasting powder, and hydraulic cement that hardened under water. Advancements such as these helped workers pull stumps, blast rock, and harden the foundation of the canal.

> *"New Yorkers have built the longest canal, in the least time, with the least experience, for the least money and to the greatest public benefit."*
>
> – William L Stone, Official Chronicler of the Event

The need for the Erie Canal was driven by the high costs and the amount of time required to move people and goods. Upon completion, the cost of moving freight within the country dropped 90%, from $95 to $125 per ton prior to construction of the canal, to $4 to $6 per ton after its construction (Morganstine and Cregg 2001). Additionally, the cross-state travel time decreased from four to six weeks to just six days (Morganstine and Cregg 2001). The businesses and industries that developed to meet the needs of the canal traffic fueled population growth in the cities and towns along the canal. From 1830 to 1850 the population of major cities and towns along the canal increased two-fold, even tripling in some areas. The

canal was instrumental in opening up the Midwest to settlement and made New York City the nation's busiest port and a hub of world trade.

Source: New York City Department of Education

***Marriage of the Waters*, oil on canvas mural by Charles Yardley Turner, 1905**

Two major engineering challenges faced builders of the Erie Canal when it came to building the section of the canal that went through the Niagara Escarpment: the steep, 60-foot descent from the top to the bottom of the escarpment, and the limestone geology. After evaluating several locations in Niagara County, engineers ultimately decided to construct a double set of five locks. The "Flight of Five," constructed where Lockport is today, allowed boats to make the ascent up the 60-foot change in elevation over the Niagara Escarpment. The limestone on the escarpment had to be manually cut and blasted, dangerous and backbreaking work, given the tools and technology available at the time. The excavated limestone rocks from the escarpment were used in many of the early homes built around the same time. Many of these stone homes are still standing in Lockport and the surrounding area.

Source:: Erie Canal Discovery Center

The Flight of Five of Lockport, New York, shown in a 1905 postcard

Governor DeWitt Clinton opened the canal on October 25, 1825, a moment made all the more impressive by cannons at 10-mile intervals firing in consecutive order all the way to New York City, an 81-minute fusillade. Then Clinton boarded the canal barge Seneca Chief and carried a bucket of Lake Erie water to the Atlantic, arriving nine days later. This same ceremony was also performed in reverse, pouring waters from the Atlantic Ocean into Lake Erie, commemorating what has long been called "the wedding of the waters" (Bernstein 2005).

Source: Ecology and Environment, Inc.
Lockport locks descent, Town of Lockport

Over the years the Erie Canal underwent a series of upgrades, including the transition to the Barge Canal from 1905 to 1918, which resulted in the decommissioning of the southern set of five locks in Lockport and the construction of two new larger locks. The larger locks would allow larger barges, since original design could only handle boats up to 75 tons.

Erie Canal's Impact on Lockport

Access to the Erie Canal made the City of Lockport an important location for industrial and commercial development, not only through increases in trade but also because of the hydroelectric power that was produced by the rush of water through the canal's raceways. Up until 1880, Lockport actually generated more power in the Erie Canal than Niagara Falls (Peca 2003). As a result, Lockport became a hub for innovation and invention in the mid-to-late 1800s, as evidenced by the development of the automobile radiator, the world's first commercial aluminum smelting operation, the first public school system in New York, the first commercial telegraph line, the first district heating system, the first automatic voting system, and the Lockport Glass Works Company, which manufactured highly collectible glass bottles (Peca 2003).

While Lockport's prosperity in the 19th century is directly related to the success of the Erie Canal, the decline of trade on the canal with the advent of railroads, over-the-road trucking, and automobiles from the mid-1900s to the 1970s had devastating effects on the city, and led to losses in both employment and population. Economic revitalization, however, is under way today as the city develops programs to promote its historical assets and increase tourism.

2.5 Underground Railroad

The Niagara region as a whole, and the Niagara Escarpment in particular, played critical roles in the success of the Underground Railroad during the 19th century before and during the Civil War. Even though slavery had disappeared in the American North, slaves fleeing the South were still treated as fugitives and were subject to arrest and deportation where harsh punishment awaited. The Niagara River below Niagara Falls offered a perfect crossing point into Canada where slavery had been prohibited since 1793 and where the U.S. Fugitive Slave Act of 1850 did not apply. The Underground Railroad emerged slowly in the first half of the 19th century and grew into a clandestine and sophisticated network of

transportation routes, way stations, and safe houses for the slaves making their way north. Local citizens, many of them members of area churches, risked arrest to help individual slaves and entire slave families. They provided the fleeing slaves with food, clothing, safe harbor, temporary shelter, and transportation as they made their way to Canada. Historians estimate that, by the end of the Civil War in 1865, between 50,000 and 100,000 slaves had crossed into Canada, many of them by passing along the escarpment.

Lewiston, New York, at the foot of the Niagara Escarpment, was one of the last stops through Western New York before the slaves crossed the Niagara River to freedom in Canada. There are other known stops along the Niagara Escarpment on the Underground Railroad, including locations in Middleport, Lockport, and Pekin, where fugitive slaves stopped on their way to Lewiston.

Source: Historical Association of Lewiston

Rebuilt Tryon's Folly with original cellars, ca 1986

The final stop of the Underground Railroad at Lewiston was a house owned by Josiah Tryon. Originally built for his wife, the building was dubbed a "folly," or foolish endeavor, when Josiah's beloved refused to live in the picturesque homestead her husband had constructed. Once Josiah Tryon realized the house could safely harbor slaves in its intricate, multilevel, interconnecting basement rooms, it became an integral stepping stone to freedom for countless people. Its success as a safe haven during an important time in U.S. history contradicts its name, but the original nickname, Tryon's Folly, has remained to this day. The house's location about 60 feet from the Niagara River provided escaping slaves quick access to the rowboats that took them safely across the river under cover of darkness. While the original home was built in 1830, all but the cellars were destroyed in a fire in the early 1900s. The home was rebuilt around 1914 over the original cellars. It exists today as a private residence.

Today, the Niagara Falls Underground Railroad Heritage Area in the City of Niagara Falls tells the story of the courageous fugitives and facilitators who made the Underground Railroad successful. One of the anchors of the Heritage Area is The Historic McClew Farmstead at Murphy Orchards in Burt, NY just north of the escarpment, where the orchards receive the benefits of the escarpment-generated and moderating microclimate. The history of this 65-acre 1850 farmstead is also preserved by its status as a Town of Newfane Local Historic Landmark and its linkage with the New York State Heritage Trail and the National Park Service Underground Railroad Network to Freedom.

Source: Ecology and Environment, Inc.

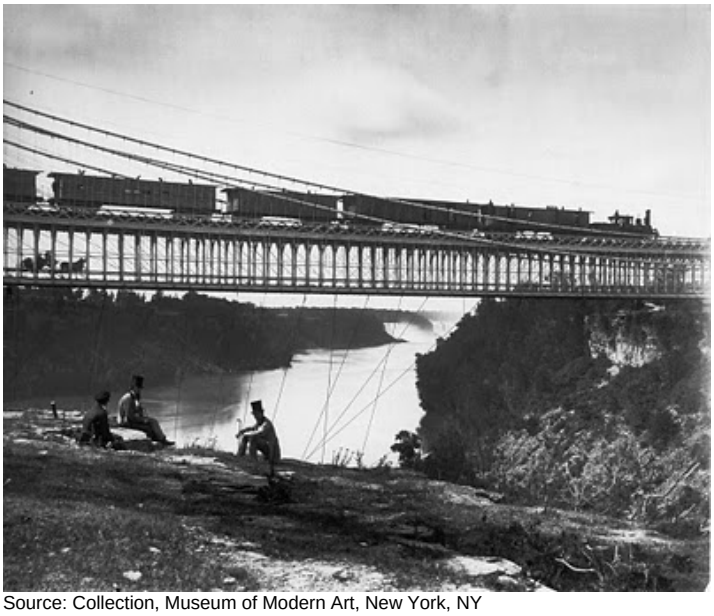
Freedom Crossing Monument, Susan Geissler Sculptor, Lewiston, New York

Freedom Crossing Monument

The Freedom Crossing Monument, located at Lewiston Landing and created by Susan Geissler of Youngstown, New York, depicts Laura Eastman, the fictional heroine of the novel *Freedom Crossing* (Margaret Goff Clark 1980). Clark's work of historical fiction is set in Lewiston and includes detailed descriptions of actual stops of the Underground Railroad in Lewiston, including the Presbyterian Church and Josiah Tryon's house.

Niagara Suspension Bridge Crossing

The Niagara Suspension Bridge, built in 1848, was located two and a half miles downstream from Niagara Falls. It was the first railroad and carriage bridge across the Falls and quickly became a conduit for slaves who had traveled the Underground Railroad bound for freedom in Canada. Harriet Tubman herself is said to have guided many slaves across the bridge. Thomas Root, a prominent abolitionist from Pekin, New York, had a special arrangement with a border guard at the bridge who allowed him to cross without incident when he had slaves concealed in his wagon. "We have a load of Southern calico," he'd say and pass uninspected. The bridge was dismantled in 1897 to make room for the Whirlpool Rapids Bridge. The Niagara Falls Underground Railroad Interpretive Center, on the site of the customs house across from the original site of the bridge is being readied for a late 2014 opening.



Source: Collection, Museum of Modern Art, New York, NY

William England, *Niagara Suspension Bridge*, 1859

Underground Railroad Heritage Trail

New York State has designated areas throughout upstate New York that were used to help escaped slaves to freedom in Canada as the Underground Railroad Heritage Trail. Among these sites is the Underground Railroad Heritage Trail Regional Interpretive Center for the Greater Niagara region at the Castellani Art Museum at Niagara University.

There's two things I got a right to and these are death and liberty. One or the other I mean to have."

- Harriet Tubman

2.6 Public Parks and Heritage Areas

Of the many parks and recreation areas on the escarpment, three in particular hold historical significance, and they are described below in 2.5.1. A complete listing of public areas appears in Section 3.7.1

Source: John Pfahl

Path to the whirlpool, 1985. Castellani Art Museum – Freedom Crossing exhibit.

National Heritage Areas and Parks of Historical Significance

Erie Canalway National Heritage Corridor. The Erie Canal and its surrounding communities were established as a National Heritage Corridor in 2002 and include the nearly 524 miles of navigable waterways that make up the New York State Canal System. The most significant historic site from the 1862-era Erie Canal is the one containing the Lockport locks, which are still in operating condition.

Lockport is currently considering an effort to restore the original southern five locks, the "Flight of Five," that were decommissioned during the upgrade of the canal to the Barge Canal in the early 1900s. This would be the only location along the Erie Canalway National Heritage Corridor where historic manual technology and current electrical canal lock technology would operate side by side.

Niagara Falls National Heritage Area. The Niagara Falls National Heritage Area was designated by Congress in 2008 and forms the western boundary of Niagara County along the Niagara River from Wheatfield north to the mouth of the Niagara River at Lake Ontario. As such, a portion of the Niagara Escarpment in Lewiston is located within this national heritage area, offering natural features, vast cultural histories and nationally significant historical sites to visitors.

There are three national historic landmarks within this area, as well: the Adams Power Transformer House (birthplace of modern hydroelectric power generation), the Niagara Reservation (the nation's oldest state park), and the Colonial Niagara Historic District (Lewiston and Youngstown). The ancestral and present-day home of the Tuscarora Nation, a member of the Haudenosaunee Confederacy, is located here as well. The national heritage area was the site of early European exploration and settlement, a battleground during three wars—the French and Indian War, the Revolutionary War, and the War of 1812, and one of the last, and most critical stops on the Underground Railroad.

Earl W. Brydges Artpark State Park. Earl W. Brydges Artpark is located in the Village of Lewiston. The park's current focus is on art exhibitions, art education, family events, theatrical productions, and a schedule of eclectic music concerts. The park is also home to the Lower Land Archaeological District, where portages around the Niagara Escarpment and Niagara Falls have been located since prehistoric times. The park is home to Scovell's Knoll, which has historic and ecological significance (see below). The Lewiston Mound, an archaeological site listed on the NRHP, is located on the southwestern side of the knoll and at its base.

Scovell's Knoll. Scovell's Knoll is a rocky outlier of tableland that stretches south of the crest of the Niagara Escarpment and the lower lake plain. The knoll is named for the stone mansion at its summit, built in the 1830s by Seymour Scovell. The Scovell mansion was destroyed by fire in the 1960s, although the western wall of the mansion remains. The area currently is publicly accessible via Artpark.

This knoll was formed by an erosion-resistant bedrock cap that protected the area from the leveling effects of the last glacial period. The area has unusual hydrologic features associated with fissures in the bedrock, which produce an unusual flow of water often found at the base of the Niagara Escarpment. This flow of water resulted in bog-like conditions surrounding the knoll and the creation of an unusual ecological community. Thin yellow-brown calcareous stony deposits left behind by the respiration of moss suggest that the area was once covered with masses of green moss. The unique features historically present at the knoll may have been associated with centuries of humans using this location for spiritual reasons.

Today, this area remains mostly in a disturbed state due to the construction of the Scovell mansion, archaeological excavations in the early and mid-20th century, activities associated with the New York Power Authority's construction of the Niagara power plant, and ongoing public events such as summer concerts at Artpark. The western side, which is considered the most pristine part of the knoll, is also experiencing degradation (Eckel 2004).

Lewiston Mound Historic Site. The Lewiston Mound was identified in 1903 as an ancient burial ground on the Kienuka plateau, an ancient Indian fortress existing in pre-historic times (see Section 2.1.1 for more information on Fort Kienuka). The burial grounds contained evidence of the existence of the fortress's village as well as the remains of more than 200 people who are believed to have been Neuter Indians (Lewis 1968). The burial mound's layers of bodies, soils, and rock indicate that the same mound was used for a long period of time. In the 1960s, ancient Native American artifacts were discovered that radiocarbon dating has shown to be from around 160 A.D. (within an 80-year margin). These findings place the artifacts within the cultural sequence of Paleo-Indian hunters who have been thought to have first settled in this region in approximately 7,000 B.C. (Eckel 2004).

Lower Landing Archaeological District. The Lower Landing Archaeological District is located at the base of the Niagara Escarpment. It was the northern point of the eastern portage around the escarpment connecting upper Lake Erie with Lake Ontario. This portage system was, for the most part, abandoned when the Erie Canal was constructed (Eckel 2004). This area was used during colonial periods and was home to Joncaire's Trading Post from 1719 to 1741. No remnants of these colonial activities currently remain at the site. The site was designated a National Park Service Historic District in 1998.

2.7 For Further Reading

The preceding histories barely begin to tell the story of the people who have called the Niagara Escarpment home over the centuries, or the story of those who continue to live there. Here is a sampling of the websites available to anyone interested in further information.

- Haudenosaunee Confederacy: www.haudenosauneeconfederacy.com
- Niagara County: www.niagarahistory.org
- Town and City of Lockport: elockport.com
- Town and Village of Lewiston: www.historiclewiston.org
- Town of Hartland: townofhartland.org
- Town of Royalton: townofroyalton.org
- Underground Railroad – Castellani Art Museum: http://www.freedomcrossingniagara.com/resources/index.php

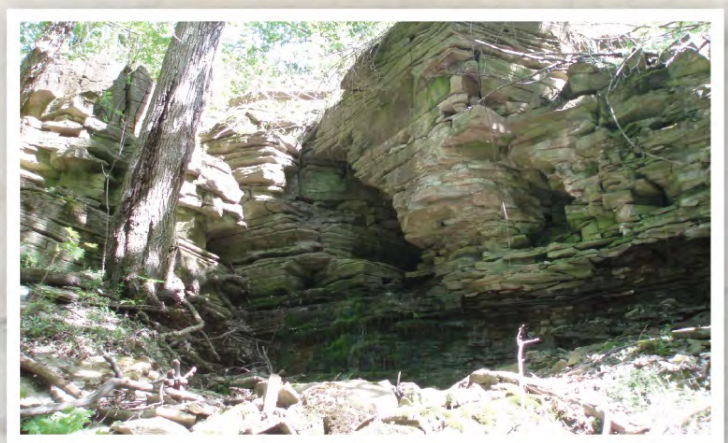
White baneberry (*Actaea pachypoda*), Lewiston

Wild ginger (*Asarum canadense L.*) in bloom, Lewiston

View from escarpment beneath summer full foliage, Cambria

Talus cave, Lockport

Headwaters of Twelve-Mile Creek, at rim of escarpment, Lewiston



Escarpment shelf, Cambria

3 Existing Resources: Inventory of the Ecology, Geology, and Land Use along the Escarpment

By completing field surveys this Project provides the Western New York community with new information about the biological resources that exist along today's Niagara County portion of the Niagara Escarpment. Our most important findings are the presence of ecological communities that had not previously been identified in our region and the confirmed presence of three threatened species of flora and four species of special concern of fauna.

The most exceptional ecological communities that were preliminarily identified in the study area were the oak openings, the alvar woodland and the alvar shrubland. Described in further detail below, evidence of an oak openings community, a rare ecological community, was identified on the escarpment. The alvar woodland is considered very vulnerable in New York State and previously had been identified only in Jefferson County (the county that includes Watertown, NY). The alvar shrubland has not been documented in this region of New York State up until now, and it is also considered vulnerable or limited in its occurrence.

The threatened species and species of special concern found in the study included the big shellbark hickory, smooth cliff brake fern, yellow giant hyssop, Cooper's hawk, grasshopper sparrow, vesper sparrow, and blue-spotted salamander.

3.1 Ecological Regions and Communities

Ecoregions are areas of generally similar ecosystems based on the type, quality, and quantity of environmental resources. Designating ecological regions is critical to structuring and implementing ecosystem management strategies across federal agencies, state agencies, and non-governmental organizations. The Study Area is located in the Erie and Ontario Lake Plain ecoregion (see Figure 3.1-1).

The retreat of the Wisconsin glacier approximately 12,000 years ago had a great influence on the formation of the Niagara Escarpment. It formed surface drainage patterns and ravines that are evident in today's landscape. The combined compression and rebound of land as a result of ice cover, estimated at between one and two miles thick, and subsequent glacial melting contributed to soil deposition and unique rock exposures that support today's unique plant

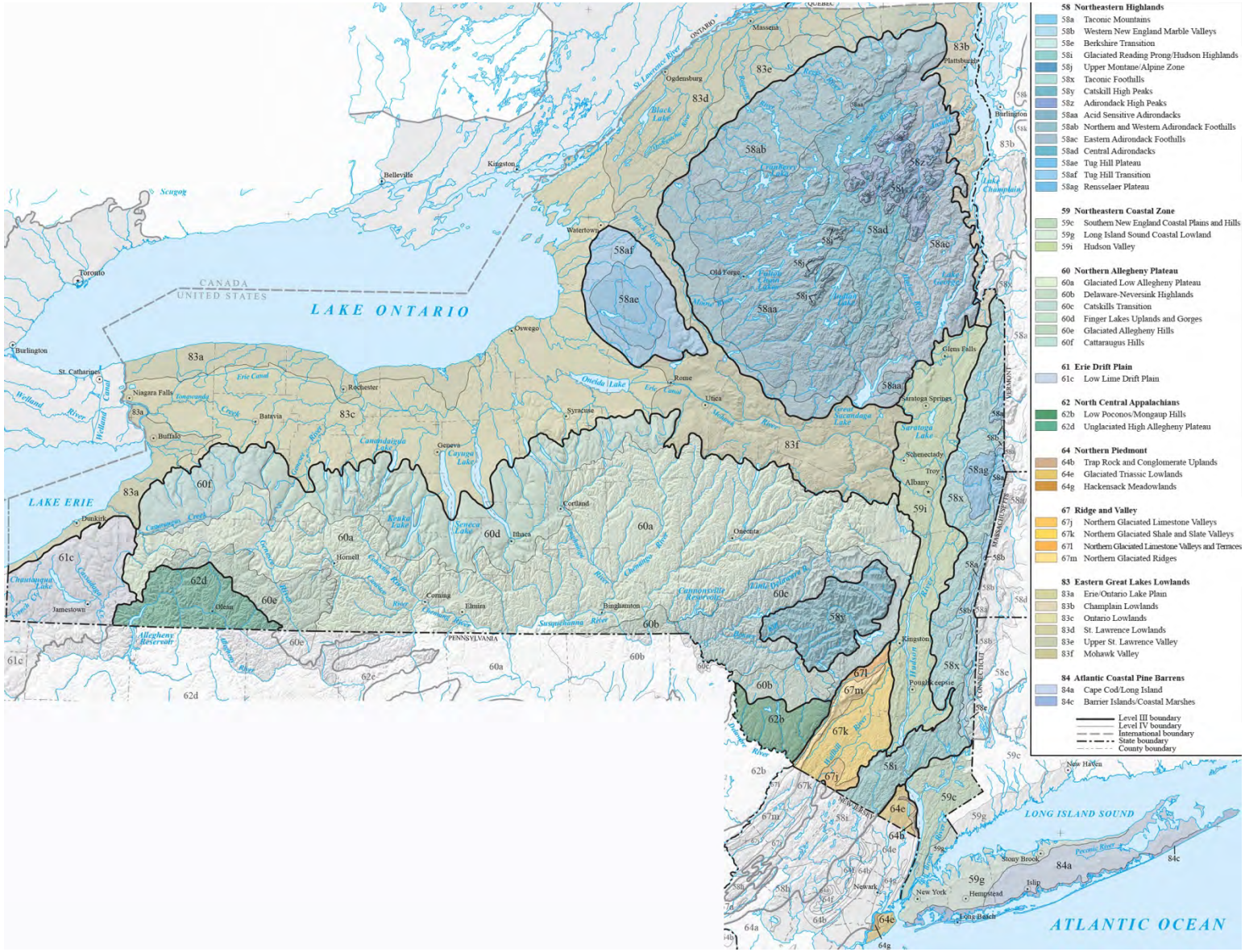


Figure 3.1-1 Ecoregions of New York State

communities. The escarpment geology, flora, and faunal species assemblages in the Erie and Ontario Lake Plain ecoregion are examples of unique ecological communities and habitats similar in associations but distinct from those found in the Niagara River Gorge. The east-west orientation, the proximity to Lake Ontario, and the micro-environments created by bedrock, cliff exposure, and aspect, as well as subsurface hydrology, all contribute to the diversity of plant and animal species present along the escarpment.

An ecological community is a group of two or more potentially interacting species that occupy a common environment. Defining and identifying ecological communities along the Niagara Escarpment is essential to understanding the region's distribution of ecological boundaries. Factors such as soil, physiography, climate, hydrology, geology, and vegetation form a compounding array of features that help define species distribution (Omernik 1995). Ecological communities represent a "coarse filter," an analysis of biodiversity at a larger scale than the species level. Their identification and documentation can be used to describe whole groups of plant and animal species, both common and rare. Rare animals and plants often have narrow or unusual habitat requirements. These species may "fall through" the coarse filter and are sometimes not identified in the representative communities. Identifying and documenting viable populations of each of the rare species serves as the "fine filter" for understanding the ecological diversity of the community.

Ecological Community Classification Methodology

Edinger's *Ecological Communities of New York State: Second Edition* (Edinger et al. 2002) drafted for the New York Natural Heritage Program (NYNHP), describes and organizes ecological communities into several large systems: marine and estuarine, riverine, lacustrine, palustrine, terrestrial, and subterranean.

To identify ecological communities in New York State, ecologists at NYNHP established criteria and conservation guides for animals, plants, and communities and rarity rank descriptions (http://www.acris.nynhp.org) that further identify indicators and characteristics of these communities. NYNHP guidance was used to preliminarily identify the ecological communities located within the Project. Site data and photographs collected during Project surveys along the escarpment can confirm the presence or absence of defined ecological communities. The NYNHP criteria and guidance for identifying ecological communities has been valuable to both conservationists and land managers in New York to "identify locations of high quality natural communities across the state." Observations regarding ecological communities made during this Project should ultimately be provided to the NYNHP for confirmation and inclusion in their mapping database (Edinger et al. 2002).

The ecological systems found on the Niagara Escarpment are the terrestrial, palustrine, riverine, and subterranean (described in further detail below). Descriptions and characteristic species are based on NYNHP community

classification system (Edinger et al. 2002). Figure 3.1-1 depicts the ecoregions of New York State, and Table 3.1-1 lists the hierarchy of ecological communities found in the Study Area.

Table 3.1-1 Ecological Communities in the Study Area

Terrestrial System
■ Open uplands subsystem - Alvar shrublands ■ Woodlands subsystem - Limestone woodlands - Alvar woodlands - Calcareous cliff - Calcareous talus slope woodlands ■ Forested uplands subsystem - Rich mesophytic forest - Maple-basswood rich mesic forest
Palustrine System
■ Open mineral soil wetlands subsystem - Shallow emergent marsh ■ Forested mineral soil wetlands subsystem - Floodplain forest - Vernal pools
Riverine System
■ Natural subsystem - Spring/seep - Perennial stream - Intermittent stream ■ Riverine cultural subsystem - Canal
Subterranean System
■ Natural caves subsystem - Talus cave

Field survey data, observations, and photographs of plants and animals were recorded during site investigations in spring and summer 2013. The Project field surveys were qualitative, with the process of data collection focused on geological features, surface hydrology, plant communities, and wildlife observations. The field surveys documented the presence of indicators and attributes of representative ecological communities. Although an abundance of detailed information was collected from each site, data and findings contained in this report are considered a general characterization and not a complete resource inventory of the sites surveyed on the escarpment. Seasonal precipitation, temperature, and other weather factors can alter growing conditions in any given year to affect the presence or absence of plant and animal species. Additional

field surveys at locations throughout the escarpment are needed to further support the observations and interpretations of the ecological community types identified for this Project.

The field data collected for this Project were evaluated and compared with Edinger's *Ecological Communities of New York State* to identify mutually similar features. Table 3.1-2 provides a summary of the complete ecological community assessment and identifies where ecological communities were tentatively identified, based on documentation of features that may be similar to Edinger's descriptions of such ecological communities. Due to the qualitative nature and duration of the field surveys, additional surveys will be required to confirm the presence or absence of each ecological community. Therefore the absence of a plant species in field survey data is not indicative of the plant's absence along the Niagara Escarpment, only that the plant species was not observed during the 2013 field surveys. Additional field surveys should be conducted to enhance the inventory of known species identified along the escarpment. The occurrence of representative plant species, geological features, hydrology, and general landscape position all are indicators that support identification of ecological communities. The most notable of ecological communities are also described in the text below.

A description of field survey methodology is located in Appendix B. A botanical atlas is provided in Appendix D.

Table 3.1-2 Ecological Communities Identified by Field Surveys

Community Type (NYNHP State Rank)[1]	Number of Identified Sites	Towns	Site Numbers
Alvar shrubland[2] (S2S3)	8	Town of Lewiston Town of Cambria Town of Lockport Town of Royalton	3, 4, 5, 9, 10, 11, 13, and 19
Limestone woodland (S2S3)	13	Town of Lewiston Town of Cambria Town of Lockport City of Lockport Town of Royalton	3, 4, 5, 6, 7, 9, 10, 11, 13, 14, 15, 17, and 18
Alvar woodland[1] (S2)	7	Town of Lewiston Town of Cambria Town of Lockport Town of Royalton	3, 4, 5, 6, 11, 13, and 17
Calcareous cliff (S3S4)	7	Town of Lewiston Town of Cambria Town of Lockport Town of Royalton	3, 4, 7, 10, 15, 16, and 18

Table 3.1-2 Ecological Communities Identified by Field Surveys

Community Type (NYNHP State Rank)[1]	Number of Identified Sites	Towns	Site Numbers
Calcareous talus slope woodland (S3)	14	Town of Lewiston Town of Cambria Town of Lockport City of Lockport Town of Royalton	3, 4, 5, 6, 7, 9, 10, 11, 13, 14, 15, 16, 17, and 18
Rich mesophytic forest[3] (S2S3)	8	Town of Lewiston Town of Cambria Town of Lockport Town of Royalton	3, 5, 7, 9, 10, 15, 16, and 17
Maple-basswood rich mesic forest (S3)	15	Village of Lewiston Town of Lewiston Town of Cambria Town of Lockport City of Lockport Town of Royalton	2, 3, 4, 5, 7, 8, 9, 10, 11, 13, 14, 15, 16, 17 and 18
Shallow emergent marsh (S5)	12	Village of Lewiston Town of Lewiston Town of Cambria Town of Lockport City of Lockport Town of Royalton	1, 3, 4, 7, 9, 10, 11, 13, 14, 15, 16, 17 and 18
Floodplain forest (S2S3)	4	Town of Lockport Town of Royalton	15, 16, 17 and 18
Vernal pools (S3S4)	11	Town of Lewiston Town of Cambria Town of Lockport City of Lockport Town of Royalton	3, 5, 7, 10, 11, 13, 14, 15, 16, 17 and 18
Spring or seep (S3S4)[4]	11	Town of Lewiston Town of Cambria City of Lockport Town of Lockport Town of Royalton	3, 4, 5, 7, 9, 10, 14, 15, 16, 17 and 18
Perennial stream (S4)	13	Town of Lewiston Town of Cambria Town of Lockport City of Lockport Town of Royalton	3, 4, 5, 7, 9, 10, 13, 14, 15, 16, 17, 18 and 19

Table 3.1-2 Ecological Communities Identified by Field Surveys

Community Type (NYNHP State Rank)[1]	Number of Identified Sites	Towns	Site Numbers
Intermittent stream (S4)	11	Village of Lewiston Town of Cambria Town of Lockport City of Lockport Town of Royalton	2, 3, 5, 7, 10, 13, 14, 15, 16, 17 and 18
Talus caves (S3S4)	5	Town of Lewiston Town of Cambria Town of Royalton	3, 4, 5, 10 and 18
Oak openings[5] (S1)	1	Town of Lockport	11

Notes:

[1] NYNHP Element Occurrence Rank (NYNHP 2001).

[2] The presence of alvar communities is based on identified vegetation known to be in these communities; however, this has not yet been confirmed by NYNHP.

[3] Rich mesophytic forest characteristics were observed in small areal extents or inclusions of 1 to 3 acres within larger sites and do not represent the entire site. These forests are found on benches or flat topography at the base of slopes with higher percentage of surface soil and less talus or boulders.

[4] NYNHP has indicated a question exists regarding this state rank.

[5] Only one site was determined to warrant additional investigation, and collected field data were not sufficient to include a comprehensive analysis of this ecological community.

Key:

S = Typically fewer than 5 occurrences, endangered/critically impaired in New York State; or is extremely vulnerable to extirpation from New York State due to biological factors.

S2 = Typically 6 to 20 occurrences, few remaining individuals, acres, or miles of stream, or factors demonstrably making it very vulnerable in New York State.

S3 = Typically 21 to 100 occurrences, limited acreage, or miles of stream in New York State.

S4 = Apparently secure in New York State.

S5 = Demonstrably secure in New York State.

> *"I work on [ecological] community classification that is statewide, regional, and national, as it contributes to the NYNHP program needs and work in state parks. Although this escarpment project captures only a small portion of state parks land (Artpark), my involvement is very important to our understanding of the natural communities and rare species that occur from the Niagara to the Onondaga Escarpment."*
>
> - Julie Lundgren, NYNHP

The ecological communities discussed here were classified based on field-identified species that are known to occur in such communities. The preliminary identification of these communities was reviewed by Julie Lundgren, an ecologist with the NYNHP of the State University of New York College of Environmental Science and Forestry (SUNY ESF). Ms. Lundgren's work for the SUNY Research Foundation is a collaborative effort with NYSDEC and is funded by OPRHP, primarily for work on state park lands.

3.1.1 Terrestrial System

The terrestrial system is a broad category that includes upland habitats with well-drained soils, plants characteristic of upland vegetation, and occasional flooding. Of the numerous terrestrial subsystems described by Edinger, the following were observed during the 2013 field work: open uplands, woodlands, forested uplands, open mineral soil wetlands, forested mineral soil wetlands, natural streams, and riverine cultural and natural caves. Each of these subsystems is further divided into more specific ecological community types. Those observed along the Niagara Escarpment include alvar shrublands, limestone woodlands, alvar woodlands, calcareous talus slope woodlands, oak openings, maple-basswood rich mesic forest, shallow emergent marsh, floodplain forest, vernal pools, spring/seep, perennial stream, intermittent stream, canal, and talus caves. Each of these subsystems and the ecological community types found in each subsystem are described below.

3.1.1.1 Open Uplands Subsystem

Open uplands are upland communities with less than 25% tree canopy. The vegetation is predominantly shrubs, herbs, or mosses and lichens. One open upland community type surveyed in the Study Area was preliminarily identified as *alvar shrubland*.

Source: Ecology and Environment, Inc.
Possible alvar shrubland community, Town of Lockport

Alvar Shrublands

Of the species typically found on alvar shrublands statewide, 10 of the 24 characteristic plant species were identified during field surveys (Table 3.1-3). Northern white cedar (*Thuja occidentalis*) and rock elm (*Ulmus thomasii*) were not observed, but eastern red cedar (*Juniperus virginiana*) was noted on some sites near Lockport. It is possible that white cedar has been suppressed by the

abundant deer populations. Alternatively, deer-preferred habitat may have already been occupied by other species or they were overtaken by faster-growing trees, shrubs, or invasive plants like Tartarian honeysuckle (*Lonicera tartarica*) (see Section 3.3, Table 3.3-1).

The alvar shrubland community has not been documented in this region of New York State up until now, and while Project field data indicate its existence along the escarpment, more investigation is necessary to confirm the extent of its geography. In addition, more data are needed to determine whether other alvar community types exist along the escarpment, including alvar grassland and alvar pavement-grasslands. If alvar shrublands are confirmed along the Niagara Escarpment, this would be a newly identified location since the publication of Edinger's 2002 study of ecological communities (Edinger et al. 2002). Edinger only reports their distribution in a few outcrops of Chaumont limestone in Jefferson County, in the Eastern Ontario Plain ecoregion.

Source: Ecology and Environment, Inc.

Possible alvar grassland community, Town of Lockport. At this site, small shrubs and trees surround limestone pavement, which is covered with herbaceous vegetation.

Table 3.1-3 List of Typical Plant Species in Alvar Shrublands

Common Name	Scientific Name	Identified in 2013 Surveys*
Bur oak	*Quercus macrocarpa*	X[1,2]
Chokecherry	*Prunus virginiana*	X[2]
Common juniper	*Juniperus communis*	

Table 3.1-3 List of Typical Plant Species in Alvar Shrublands

Common Name	Scientific Name	Identified in 2013 Surveys*
Common snowberry	*Symphoricarpos albus*	
Downy arrow-wood	*Viburnum rafinesquianum*	
Eastern red cedar	*Juniperus virginiana*	X[1]
Fragrant sumac	*Rhus aromatica*	
Gray dogwood	*Cornus racemosa*	X[1,2]
Juneberry	*Amelanchier* spp.	
Kinnikinnick	*Arctostaphylos uva-ursi*	
Limber honeysuckle	*Lonicera dioica*	
Northern white cedar	*Thuja occidentalis*	
Poison ivy	*Toxicodendron radicans*	X[1,2]
Poverty grass	*Danthonia spicata*	
River bank grape	*Vitis riparia*	X[1,2]
Rock elm	*Ulmus thomasii*	
Round-leaf dogwood	*Cornus rugosa*	X[1,2]
Russet buffaloberry	*Shepherdia canadensis*	
Sedge	*Carex* sp.	
Shagbark hickory	*Carya ovata*	X[1,2]
Smooth rose	*Rosa blanda*	
Upland white aster	*Oligoneuron albu*	
White ash	*Fraxinus americana*	X[1,2]

Notes:
An "X" indicates that the plant species was observed in the field surveys. The superscript "1" indicates it was observed in the spring surveys; a "2" indicates its presence in the summer surveys.
* The absence of a plant in field survey data does not indicate that the plant was not present on the site, only that it was not observed.

3.1.1.2 Woodlands Subsystem

According to Edinger, woodlands include communities with a canopy of stunted or dwarf trees (measuring less than 16 feet [4.9 meters] tall), and wooded communities occurring on shallow soils over bedrock with numerous rock outcrops. The woodlands community types believed to exist along the Niagara Escarpment are limestone woodlands, alvar woodlands, and calcareous talus slope woodlands, each of which are described below.

Limestone Woodlands

The limestone woodlands community type is a low-density forest in shallow soils over limestone bedrock, typically distributed throughout upstate New York. These communities contain numerous outcrops and can have either an open or closed canopy layer. During field surveys, 20 out of the 35 characteristic plant species for the limestone woodland community were identified (Table 3.1-4). The absence of a spring ephemeral species from the summer surveys does not necessarily indicate the absence of that species from the Niagara Escarpment.

Source: Ecology and Environment, Inc.

Limestone woodlands community type, with trees growing in shallow soils amongst limestone bedrock.

Table 3.1-4 List of Typical Species in Limestone Woodlands

Common name	Scientific name	Identified in 2013 Surveys*
Alder-leaf buckthorn	*Rhamnus alnifolia*	
American basswood	*Tilia americana*	X[1,2]
American bladdernut	*Staphylea trifolia*	X[1,2]
Balsam fir	*Abies balsamea*	
Barren strawberry	*Waldsteinia fragarioides*	X[1]
Big-leaf aster	*Aster macrophyllus*	
Black snakeroot	*Sanicula marilandica*	
Blue-stem goldenrod	*Solidago caesia*	X[2]
Bracken fern	*Pteridium aquilinum*	
Bur oak	*Q. macrocarpa*	X[1,2]
Canada mayflower	*Maianthemum canadense*	X[1]
Early meadow rue	*Thalictrum dioicum*	X[1]
Eastern hop hornbeam	*Ostrya virginiana*	X[1,2]
False Solomon's-seal	*Smilacina racemosa*	X[1,2]
Gray dogwood	*Cornus racemosa*	X[1,2]
Herb-robert	*Geranium robertianum*	X[1,2]
Juneberry	*Amelanchier* spp.	
Limber honeysuckle	*Lonicera dioica*	
Maidenhair spleenwort	*Asplenium trichomanes*	X[1]
Marginal wood fern	*Dryopteris marginalis*	X[1,2]
Northern red oak	*Q. rubra*	X[1,2]

Table 3.1-4 List of Typical Species in Limestone Woodlands

Common name	Scientific name	Identified in 2013 Surveys*
Northern white cedar	*Thuja occidentalis*	
Poison ivy	*Toxicodendron radicans*	X[1,2]
Prickly gooseberry	*Ribes cynosbati*	X[1,2]
Raspberries	*Rubus idaeus, R. occidentalis*	
Rattlesnake fern	*Botrychium virginianum*	
Rock polypody	*Polypodium virginianum*	
Sedges	*Carex eburnea, C. pensylvanica, C. platyphylla*	X[1]
Shagbark hickory	*Carya ovata*	X[1,2]
Sugar maple	*Acer saccharum*	X[1,2]
White oak	*Quercus alba*	X[1,2]
White pine	*Pinus strobus*	
White spruce	*Picea glauca*	
White trillium	*Trillium grandiflorum*	
Wild strawberry	*Fragaria virginiana*	X[1]

Notes:

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An "X" indicates that the plant species was observed in the field surveys. The superscript "1" indicates it was observed in the spring surveys; a "2" indicates its presence in the summer surveys.

* The absence of a plant in field survey data does not indicate that the plant was not present on the site, only that it was not observed.

Alvar Woodlands

Although NYNHP currently identifies alvar woodlands only in Jefferson County (NYNHP 2002), field observations indicate that the communities at many of the field sites resemble alvar woodlands. It is thought that the alvar woodlands may be a later successional stage of the alvar shrublands discussed earlier. Many tree species identified during field surveys also occur in the limestone woodlands, so additional analysis and/or data are needed to confirm the correct classification of these sites. The characteristic plant species found in alvar woodlands are listed in Table 3.1-5.

A likely example of the alvar woodland community type along the escarpment is a private parcel in the Town of Lockport. The limestone bedrock exposure across the majority of the site was historically used as pastureland. It is densely covered with shrub species like gray dogwood, prickly ash (*Zanthoxylum americanum*), hawthorn (*Crataegus sp.*), Tartarian honeysuckle, and staghorn sumac with some wetland inclusions represented by depressional areas within an otherwise level landscape. The site does exhibit occasional hardwood species like sugar maple, pin cherry, and hackberry (*Celtis occidentalis*), but canopy cover is far less than 25%. On the same property, near the western property line, is a mature forested area containing a knoll that rises to an apex and falls in all directions from the center. The knoll contains many scattered rocks and boulders and supports ecologically diverse features. The community type shifts from an alvar woodland to a calcareous talus slope woodland. Tree species on the knoll include sugar

maple, eastern hop hornbeam, black cherry (*Prunus serotina*), pin cherry, and apple trees (*Malus spp.*), increasing the canopy cover to at least 50%. Herbaceous vegetation on the knoll includes many spring ephemeral plants such as blue cohosh, white baneberry (*Actaea pachypoda*), wild ginger (*Asarum canadense*), bloodroot (*Sanguinaria canadensis*), and hepatica (*Hepatica sp.*). In August, the majority of this site is dominated by green violets (*Hybanthus concolor*). Shrub species present include red berry elder (*Sambucus racemosa*), American bladdernut, silky dogwood (*Cornus amomum*), and an occasional prickly ash, which may be limited by canopy shade conditions.

Source: Ecology and Environment, Inc.
Possible alvar woodland community, Town of Lockport.

Table 3.1-5 List of Typical Plant Species in Alvar Woodlands

Common Name	Scientific Name	Identified in 2013 Surveys*
American basswood	*Tilia americana*	X[1,2]
American elm	*Ulmus americana*	X[1]
Balsam fir	*Abies balasamea*	
Balsam ragwort	*Senecio pauperculus*	
Bristleleaf sedge	*Carex eburnea*	
Bur oak	*Quercus macrocarpa*	X[1,2]
Common juniper	*Juniperus communis*	
Crawe's sedge	*Carex crawei*	
Eastern hop hornbeam	*Ostrya virginiana*	X[1,2]
Eastern red cedar	*Juniperus virginiana*	X[1]

Table 3.1-5 List of Typical Plant Species in Alvar Woodlands

Common Name	Scientific Name	Identified in 2013 Surveys*
False pennyroyal	*Hedeoma pulegioides*	
Grimmia	*Schistidium spp.*	
Jack pine	*Pinus banksiana*	
Kinnikinnick	*Arctostaphylos uva-ursi*	
Lichens	*Cladina rangiferina, Peltogera canina*	
Northern white cedar	*Thuja occidentalis*	
Paper birch	*Betula papyrifera*	
Pin cherry	*Prunus pensylvanica*	X[1]
Poverty dropseed	*Sporobolus vaginiflorus*	
Richardson's sedge	*C. richardsonii*	
Rock elm	*Ulmus thomasii*	
Rock surface algae	*Gloeocapsa alpina*	
Russet buffaloberry	*Shepherdia canadensis*	
Shagbark hickory	*Carya ovata*	X[1,2]
Twisted moss	*Tortella spp.*	
White ash	*Fraxinus americana*	X[1,2]
White pine	*Pinus strobus*	X[2]
White spruce	*Picea glauca*	

Notes:
An "X" indicates that the plant species was observed in the field surveys. The superscript "1" indicates it was observed in the spring surveys; a "2" indicates its presence in the summer surveys.
* The absence of a plant in field survey data does not indicate that the plant was not present on the site, only that it was not observed.

Calcareous Talus Slope Woodlands

The calcareous talus slope woodland community consists of talus (rock fragments), gradients of calcareous (limestone or dolomite) bedrock, and moist, loamy soil with either an open or closed canopy (NYNHP 2002). Calcareous talus slope woodland communities are located throughout upstate New York, north of the Coastal Lowlands ecoregion. The characteristic plant species of the calcareous talus slope woodland are listed in Table 3.1-6.

Source: Ecology and Environment, Inc.

Example of calcareous talus slope woodland, Town of Cambria.

Table 3.1-6 List of Typical Plant Species in Calcareous Talus Slope Woodlands

Common Name	Scientific Name	Identified in 2013 Surveys*
American basswood	*Tilia americana*	X[1]
American bittersweet	*Celastrus scandens*	X[2]
American bladdernut	*Staphylea trifolia*	X[1,2]
Bloodroot	*Sanguinaria canadensis*	X[1,2]
Blue cohosh	*Caulophyllum thalictroides*	X[1,2]
Blue-stem goldenrod	*Solidago caesia*	X[2]
Bottlebrush grass	*Elymus hystrix*	X[2]
Bulbet fern	*Cystopteris bulbifera*	X[1]
Butternut	*Juglans cinerea*	X[1,2]
Climbing fumitory	*Adlumia fungosa*	
Downy arrowwood	*Viburnum rafinesquianum*	
Early meadow-rue	*Thalictrum dioicum*	X[1]
Eastern hop hornbeam	*Ostrya virginiana*	X[1,2]
Eastern red cedar	*Juniperus virginiana*	X[1]
Herb Robert	*Geranium robertianum*	X[1]
Lady fern	*Athyrium filix-femina var. asplenioides*	X[1]
Lyre-leaved rock cress	*Arabis lyrata*	
Maidenhair spleenwort	*Asplenium trichomanes*	X[1]
Northern white cedar	*Thuja occidentalis*	
Prickly ash	*Zanthoxylum americanum*	X[1,2]

Table 3.1-6 List of Typical Plant Species in Calcareous Talus Slope Woodlands

Common Name	Scientific Name	Identified in 2013 Surveys*
Ricegrass	*Oryzopsis racemosa*	
Round-leaf dogwood	*Cornus rugosa*	X[1,2]
Slippery elm	*Ulmus rubra*	X[1,2]
Solomon's seal	*Polygonatum pubescens*	X[2]
Splendid feather moss	*Hylocomium splendens*	
Sugar maplee	*Acer saccharum*	X[1,2]
Virginia creeper	*Parthenocissus quinquefolia*	X[1,2]
Walking fern	*Asplenium rhizophyllum*	
Western oak fern	*Gymnocarpium dryopteris*	
White ash	*Fraxinus americana*	X[1,2]
White baneberry	*Actaea pachypoda*	X[1,2]
White wood aster	*Aster divaricatus* (former) *Eurybia divaricata* (current)	X[1,2]
Wild ginger	*Asarum canadense*	X[1,2]

Notes:
An "X" indicates that the plant species was observed in the field surveys. The superscript "1" indicates it was observed in the spring surveys; a "2" indicates its presence in the summer surveys.
* The absence of a plant in field survey data does not indicate that the plant was not present on the site, only that it was not observed.

Many sites along the escarpment show variable extents of calcareous talus slope woodland, but one in particular, located in the Town of Lockport, is a wetland and stream recharge at the bottom of a slope and a forest and understory that are consistent with the typical composition of talus slope woodlands.

Oak Openings

Oak openings are grass-savannah communities occurring on well-drained soils, per Edinger's description. In New York this community is characterized by the broadly spread canopies of chinquapin oak (*Quercus muhlenbergii*), white oak (*Q. alba*), and black oak (*Q. velutina*). Field data from eastern portions of a Lockport site indicate chinquapin oak occurs on fractured limestone pavement with interstices of varying width. Although the geology and indicator species of this community are consistent with field data, additional field data are needed to request NYNHP confirmation of this rare (S1) ecological community. An S1 ecological community is considered extremely rare (fewer than 5 populations) or extremely vulnerable to extirpation from New York State. The location, size, and level of disturbance are indicators that this site could be a remnant of a much larger community type that has been reduced by agriculture, logging, or other land modification. The presence of chinquapin oak at this Lockport site and sparse vegetation in the shrub and herbaceous layers combined with evidence of historic site disturbance warrants further investigation to understand the community type, habitat restoration, or enhancement potential.

3.1.1.3 Forested Upland Subsystem

According to Edinger, forest upland subsystems include upland communities with more than 60% tree canopy cover. These communities occur on substrates with less than 50% rock outcrop or shallow soil over bedrock (NYNHP 2002). The forested upland subsystem community type believed to exist along the escarpment is the maple-basswood rich mesic forest.

Maple-Basswood Rich Mesic Forest

Maple-basswood rich mesic forest is a hardwood forest occurring on well-drained, moist soils with nearly neutral pH (NYNHP 2002). These forests are primarily distributed throughout the Great Lakes ecoregion and, as the name implies, are dominated by sugar maple, American basswood, and white ash (*Fraxinus americana*) species.

Many sites along the escarpment support maple-basswood rich mesic forests, with tree canopy layers of sugar maple, basswood, eastern hop hornbeam, and shagbark hickory. Many sites contain layers of blue cohosh, false Solomon's seal, and herb Robert consistent with the typical maple-basswood rich mesic forest communities described by Edinger (Table 3.1-7). Late summer and fall blooming species require additional investigation to confirm their presence or absence within the escarpment Study Area.

Source: Ecology and Environment, Inc.

Example of maple-basswood rich mesic forest, Town of Lewiston.

Table 3.1-7 List of Typical Species in Maple-Basswood Rich Mesic Forest

Common Name	Scientific Name	Identified in 2013 Surveys*
Alternate-leaved dogwood	*Cornus alternifolia*	X[1,2]
American basswood	*Tilia americana*	X[1]
American beech	*Fagus grandifolia*	X[1,2]
American hornbeam	*Carpinus caroliniana*	X[1,2]
Bitternut hickory	*Carya cordiformis*	X[1]
Bloodroot	*Sanguinaria canadensis*	X[1,2]
Blue cohosh	*Caulophyllum thalictroides*	X[1,2]
Bulbet fern	*Cystopteris bulbifera*	X[1]
Butternut	*Juglans cinerea*	X[1,2]
Dutchman's breeches	*Dicentra cucullaria*	X[1]
Early meadow-rue	*Thalictrum dioicum*	X[1]
Eastern waterleaf	*Hydrophyllum virginianum*	X[2]
False Solomon's seal	*Maianthemum racemsoum*	X[1,2]
Foam flower	*Tiarella cordifolia*	
Glade fern	*Athyrium pycnocarpon*	
Goldie's fern	*Dryopteris goldiana*	
Herb Robert	*Geranium robertianum*	X[1,2]
Ironwood (Eastern hop hornbeam)	*Ostrya virginiana*	X[1,2]
Lady fern	*Athyrium filix-femina var. asplenioides*	X[1]
Maidenhair fern	*Adiantum pedatum*	
Mountain maple	*Acer spicatum*	
Nodding trillium	*Trillium cernuum*	
Northern red oak	*Quercus rubra*	X[1,2]
Purple trillium	*Trillium erectum*	
Sedges	*Carex plantaginea*, *C. platyphylla* and *C. albursina*	X[1]
Shagbark hickory	*Carya ovata*	X[1,2]
Silvery glade fern	*Athyrium thelypteroides*	
Spring beauty	*Claytonia virginica*	X[1]
Squirrel-corn	*Dicentra canadensis*	X[1]
Sugar maple	*Acer saccharum*	X[1,2]
Toothwort	*Dentaria diphylla*	
Trout lily	*Erythronium americanum*	X[1]
Tulip tree	*Liriodendron tulipifera*	X[1]
White ash	*Fraxinus americana*	X[1,2]
White baneberry	*Actaea pachypoda*	X[1,2]
Wild ginger	*Asarum canadense*	X[1,2]

Table 3.1-7 List of Typical Species in Maple-Basswood Rich Mesic Forest

Common Name	Scientific Name	Identified in 2013 Surveys*
Wild leek	*Allium tricoccum*	X[1,2]
Witch hazel	*Hamamelis virginiana*	X[1,2]
Yellow birch	*Betula alleghaniensis*	

Notes:
An "X" indicates that the plant species was observed in the field surveys. The superscript "1" indicates it was observed in the spring surveys; a "2" indicates its presence in the summer surveys.
* The absence of a plant in field survey data does not indicate that the plant was not present on the site, only that it was not observed.

3.1.2 Palustrine System

The palustrine (wetland) system is a broad category of non-tidal, perennial wetlands characterized by emergent vegetation (Edinger et al. 2002). It includes wetlands that are permanently flooded and wetlands that are intermittently flooded (seasonally dry). Wetlands are characterized by emergent hydrophytic vegetation and hydric soils. Wetland communities are categorized by their plant composition, soil type, and frequency of flooding (Edinger et al. 2002). Although there are many palustrine subsystems that occur in New York State, only two were observed at field survey sites: open mineral soil wetlands and forested mineral soil wetlands. Each of these subsystems is further divided into shallow emergent marsh, floodplain forest community types, and vernal pools which are described below.

The USFWS defines *forested wetlands* as categorized by woody vegetation that is at least 20 feet (6 meters) tall. Forested wetlands consist of an overstory of trees, an understory of young trees or shrubs, and an herbaceous layer. *Emergent wetland* is characterized by herbaceous hydrophytic vegetation, which are plants that only grow in water or very moist soil. Vegetation is predominantly perennial and present for most of the growing season. *Scrub-shrub wetland* includes areas dominated by woody vegetation less than 20 feet (six meters) tall, including true shrubs, young trees, and trees or shrubs that are small or stunted because of environmental conditions (Cowardin 1979). Table 3.1-8 summarizes the NYSDEC- and National Wetland Inventory (NWI)-identified wetlands present in the Study Area. The evaluation of mapped NYSDEC and NWI wetlands provides an estimate of the known regulated wetlands within the Study Area but does not represent a full accounting of the wetlands in a given area. Further investigations would have to be conducted to provide an accurate account of the abundance and distribution of wetlands present in the Study Area.

Table 3.1-8 Acreage of Wetland Community Types Found within the Niagara Escarpment Study Area Mapped by the National Wetland Inventory and NYSDEC

Wetland Community Type	NYSDEC Wetland Code	Acreage[1]
NWI		
Freshwater Forested/Shrub Wetland (PFO/PSS)	Not applicable	952.4
Freshwater Emergent Wetland (PEM)	Not applicable	80.4
Freshwater Pond (PAB/PUB)	Not applicable	152.9
Other	Not applicable	2.4
Total		**1,188.1**
NYSDEC		
Class I	LP-5, LP-10	34.2
Class II	LP-24, LP-30, LP-34, LP-36, RV-11, RV-12, RV-3/RV-3 UPL	181.3
Class III	LP-16, RV-5	33.5
Total		**248.0**

Source: NYSDEC 2010 and USFWS 2002

[1] Acreage for common wetland types from multiple sites was combined.

Note: NWI- and NYSDEC-identified wetlands are not fixed boundaries in the landscape. All NWI wetlands are not confirmed extents, but these values are an indicator of surface hydrology. NWI and NYSDEC wetland acreages overlap in many areas. Ground-truthing of all wetlands is needed in this region to accurately confirm their presence or absence.

Key:
PAB = Palustrine system aquatic bed
PEM = Palustrine system emergent wetland
PFO = Palustrine system forested wetland
PSS = Palustrine system scrub-shrub
PUB = Palustrine system unconsolidated bottom

Class I; Highest quality wetland, afforded the highest level of NYS protection
Class II: Moderate quality wetland
Class III: Lower quality wetland, afforded lower levels of NYS protections

3.1.2.1 Open Mineral Soil Wetlands Subsystem

Open mineral soil wetland subsystems contain less than 50% tree canopy cover and are dominated by shrubs and herbaceous vegetation. Fluctuating water levels aerate soils in these wetlands, allowing for the decomposition of plant litter and little accumulation of peat (Edinger et al. 2002). Of the many community types in the open mineral soil wetlands subsystem, only one was observed along the field survey sites, the shallow emergent marsh.

Shallow Emergent Marsh

The shallow emergent marsh is a community that exists on deep muck or mineral soils and is permanently saturated or seasonally flooded (Edinger et al. 2002). Typical plant species are listed in Table 3.1-9.

Shallow emergent marshes are also home to a variety of amphibians, including the eastern American toad, green frog, northern spring peeper, wood frog, redback salamanders, and birds such as the red-winged blackbird, marsh wren, and common yellowthroat. Many of these species were observed during field surveys.

Source: Ecology and Environment, Inc.
Example of shallow emergent marsh, Town of Lockport.

Table 3.1-9 List of Typical Species in Shallow Emergent Marshes

Common Name	Scientific Name	Identified in 2013 Surveys
Arrowhead	*Sagittaria latifolia*	
Arrowleaf	*Peltandra virginica*	
Asters	*Aster umbellatus, A. puniceus*	X[2]
Beggerticks	*Bidens spp.*	
Blue flag iris	*Iris versicolor*	X[1]
Bluejoint grass	*Calamagrostis canadensis*	
Bulrushes	*Scirpus cyperinus, S. tabernaemontani, S. atrovirens*	
Bur-reed	*Sparganium americanum, S. eurycarpum*	
Buttonbush	*Cephalanthus occidentalis*	X[1]
Cardinal flower	*Lobelia cardinalis*	

Table 3.1-9 List of Typical Species in Shallow Emergent Marshes

Common Name	Scientific Name	Identified in 2013 Surveys
Cattails	*Typha latifolia, T. angustifolia, T. x glauca*	
Common skullcap	*Scutellaria galericulata*	
Eupatoriums	*Eupatorium maculatum, E. perfoliatum*	
Goldenrods	*Solidago rugosa, S. gigantea*	X[1,2]
Jewelweed	*Impatiens capensis*	X[1]
Loosestrifes	*Lysimachia thyrsiflora, L. terrestris, L. ciliate*	
Manna grasses	*Glyceria pallida, G. canadensis*	
Marsh bedstraw	*Galium palustre*	
Marsh bellflower	*Campanula aparinoides*	
Marsh cinquefoil	*Potentilla palustris*	
Marsh fern	*Thelypteris palustris*	
Marsh St. John's-wort	*Triadenum virginicum*	
Meadow sweet	*Spiraea alba* var. *latifolia*	
Purple loosestrife	*Lythrum salicaria*	
Purple-stem angelica	*Angelica atropurpurea*	
Reed canary grass	*Phalaris arundinacea*	X[1]
Royal and cinnamon ferns	*Osmunda regalis, O. cinnamomea*	
Rushes	*Juncus effusus, J. canadensis*	X[1,2]
Sedges	*Carex stricta, C. lacustris, C. lurida, C. hystricina, C. alata, C. vulpinoidea, C. comosa, C. utriculata, C. scoparia, C. gynandra, C. stipata, and C. crinita.*	X[1,2]
Sensitive fern	*Onoclea sensibilis*	X[1,2]
Shrubby dogwoods	*Cornus amomum, C. sericea*	X[1,2]
Smartweeds	*Polygonum coccineum, P. amphibium, P. hydropiperoides*	
Speckled alder	*Alnus incana* ssp. *rugosa*	
Spikerushes	*Eleocharis smalliana, E. obtusa*	
Swamp milkweed	*Asclepias incarnata*	X[1]
Sweet flag	*Acorus americanus*	
Tall meadow-rue	*Thalictrum pubescens*	X[1,2]
Threeway sedge	*Dulichium arundinaceum*	
Turtlehead	*Chelone glabra*	
Water docks	*Rumex orbiculatus, R. verticillatus*	
Water parsnip	*Sium suave*	X[1]
Water purslane	*Ludwigia palustris*	
Water willow	*Decodon verticillatus*	
Water-hemlock	*Cicuta bulbifera*	

Table 3.1-9 List of Typical Species in Shallow Emergent Marshes

Common Name	Scientific Name	Identified in 2013 Surveys
Water-horehounds	*Lycopus uniflorus, L. americanus*	
Willows	*Salix* spp.	X[1,2]

Notes:
An "X" indicates that the plant species was observed in the field surveys. The superscript "1" indicates it was observed in the spring surveys; a "2" indicates its presence in the summer surveys.
* The absence of a plant in field survey data does not indicate that the plant was not present on the site, only that it was not observed.

3.1.2.2 Forested Mineral Soil Wetlands Subsystem

Forested mineral soil wetland subsystems have at least 50% tree canopy cover and include seasonally flooded forests and permanently flooded or saturated swamps. Of the many community types in the forested mineral soil wetlands subsystem, two were observed along the field survey sites, the floodplain forest and vernal pools.

Floodplain Forest

The floodplain forest is broadly defined as a hardwood forest on mineral soils and is found on low terraces of river floodplains and river deltas. Low areas are flooded regularly, particularly in the springtime after ice melt; higher areas are flooded more irregularly. Typical plant species observed in floodplain forests are listed in Table 3.1-10. Floodplain forests are distributed throughout upstate New York, north of the Coastal Lowlands ecoregion.

Table 3.1-10 List of Typical Species in a Floodplain Forest

Common Name	Scientific Name	Identified in 2013 Surveys*
American basswood	*Tilia americana*	X[1,2]
American bladdernut	*Staphylea trifoliata*	X[1,2]
Ashes	*Fraxinus pensylvanica, F. nigra, F. americana*	X[1,2]
Black locust	*Robinia pseudo-acacia*	X[1]
Bluejoint grass	*Calamagrostis canadensis*	X[2]
Box elder	*Acer negundo*	X[1,2]
Butternut and black walnuts	*Juglans cinerea, J. nigra*	X[1,2]
Clearweed	*Pilea pumila*	
Cottonwood	*Populus deltoides*	X[1,2]
Dame's rockets	*Hesperis matronalis*	
Dogwoods	*Cornus sericea, C. foemina spp. racemosa, C. amomum*	X[1,2]
Elms	*Ulmus americana, U. rubra*	X[1,2]
Enchanter's nightshade	*Circaea lutetiana ssp. canadensis*	X[2]
False nettle	*Boehmeria cylindrica*	X[2]

Table 3.1-10 List of Typical Species in a Floodplain Forest

Common Name	Scientific Name	Identified in 2013 Surveys*
Garlic mustard	*Alliaria petiolata*	X[1,2]
Goldenrods	*Solidago gigantea, S. canadensis, Solidago spp.*	X[1,2]
Hackberry	*Celtis occidentalis*	X[1,2]
Hickories	*Carya cordiformis, C. ovata, C. laciniosa*	X[1,2]
Honeysuckles	*Lonicera tatarica, L. morrowii*	X[1,2]
Ironwood	*Carpinus caroliniana*	X[2]
Jack-in-the-Pulpit	*Arisaema triphyllum*	X[1,2]
Jewelweeds	*Impatiens capensis, I. pallida*	X[1,2]
Jumpseed	*Polygonum virginianum*	X[2]
Lizard's tail	*Saururus cernuus*	
Meadowsweet	*Spiraea alba var. latifolia*	
Moneywort	*Lysimachia nummularia*	
Moonseed	*Menispermum canadense*	
Multiflora rose	*Rosa multiflora*	X[1,2]
Oaks	*Quercus bicolor, Q. palustris*	X[1,2]
Ostrich Fern	*Matteuccia struthiopteris*	
Poison ivy	*Toxicodendron radicans*	X[1,2]
Red maple	*Acer rubrum*	X[1,2]
Rice cutgrass	*Leersia oryzoides*	
River birch	*Betula nigra*	
Sedges	*Carex lacustris, C. intumescens, C. lupulina*	X[1,2]
Sensitive fern	*Onoclea sensibilis*	X[1,2]
Silver maple	*Acer saccharinum*	X[1]
Skunk cabbage	*Symplocarpus foetidus*	
Speckled alder	*Alnus incana spp. rugosa*	
Spicebush	*Lindera benzoin*	X[1,2]
Stilt grass	*Microstegium vimineum*	
Sugar maple	*Acer saccharum*	X[1,2]
Sycamore	*Platanus occidentalis*	X[1]
Tulip tree	*Liriodendron tulipifera*	X[1]
Viburnums	*Viburnum cassinoides, V. prunifolium, V. dentatum, V. lentago*	X[2]
Virginia creeper	*Parthenocissus quinquefolia*	X[1,2]
Virgin's bower	*Clematis virginiana*	
White avens	*Geum canadense*	
White snakeroot	*Eupatorium rugosum*	X[2]
White willow	*Salix alba*	
Wild grapes	*Vitis riparia, Vitis* spp.	X[1,2]

Table 3.1-10 List of Typical Species in a Floodplain Forest

Common Name	Scientific Name	Identified in 2013 Surveys*
Winterberry	*Ilex verticillata*	
Wood nettle	*Laportea canadensis*	

Notes:
An "X" indicates that the plant species was observed in the field surveys. The superscript "1" indicates it was observed in the spring surveys; a "2" indicates its presence in the summer surveys.
* The absence of a plant in field survey data does not indicate that the plant was not present on the site, only that it was not observed.

Vernal Pools

During the spring, vernal pools (<0.5 acre) are often found in floodplain forests and typically occur in upland forest areas near floodplain riparian corridors or open water features. These vernal pools fill with melt water in spring and can dry out in summer. Because they are ephemeral, they are devoid of fish and thus could provide a safe breeding habitat for amphibians like the spotted salamander and Jefferson salamander, fairy shrimp, and mollusks, among others (Morgan and Calhoun 2012). Eggs produced by fairy shrimp remain in the vernal pool after it has dried and hatch in the spring when the pool refills (New York Natural Heritage Program 2013).

Source: Ecology and Environment, Inc.
Vernal pools along the Niagara Escarpment, Town of Cambria.

Each year many adult amphibians return to the same vernal pool from which they were hatched, increasing the need for vernal pool habitat to be conserved (Morgan

and Calhoun 2012). Vernal pools are threatened by development, alteration of habitat, and recreational activities.

Vernal pools were identified by reviewing wetland and soil mapping (see Appendix A) and were surveyed during spring amphibian surveys (discussed further in Section 3.2.2). While 11 of the 19 surveyed sites were documented to have vernal pools during the Project surveys, further field surveying for specific vernal pool locations is strongly recommended in order to protect and understand these sensitive habitats.

3.1.3 Riverine Systems

A riverine system (river and streams) consists of linear, flowing, non-tidal waters containing aquatic communities of abundant submerged aquatic vegetation (SAV) but sparse or non-persistent emergent riparian vegetation (Edinger et al. 2002). The main riverine subsystems are 1) natural subsystems that include streams that have not been heavily affected by human influences, and 2) riverine cultural subsystems, which are created, manipulated, and maintained by human activities (Edinger et al. 2002).

3.1.3.1 Natural Streams Subsystem

The natural stream features in the Study Area include spring/seep, perennial streams, and intermittent streams.

Spring/Seep

The spring community type is an aquatic community present in very small stream sources where flow is perennial. The streams created by these springs are generally short, shallow, and rich in dissolved oxygen (Edinger et al. 2002). Characteristic amphibians in springs include the dusky salamander (*Desmognathus fuscus fuscus*), which was identified at a number of sites (see Table 3.2-7). The springs located in the Study Area usually adjoin other aquatic communities, including vernal pools, wetlands, streams, and tributaries.

Perennial Stream

Perennial streams are natural streams in the riverine system that have year-round continuous flow. Examples from Edinger's descriptions include both marsh headwater streams, where water flows through a marsh or swamp; and rocky headwater streams, in which water flows over eroded bedrock. Both are usually part of a network of 1st or 2nd order stream segments. The major perennial streams located throughout the Study Area include Eighteen Mile Creek and its east branch, the east branch of Twelve Mile Creek, Fish Creek, and Johnson Creek (Table 3.1-10).

Intermittent Stream

Intermittent streams are defined as small streambeds in the highest segments of stream systems, in which water flow is a result of a groundwater spring or associated with heavy rain. In these streams, gradient is moderate to steep, soils

are hydric, and diverse emergent and sub-emergent lichens and fungi often cover streambeds. Intermittent streams are found throughout the Study Area and are usually tributaries to the perennial streams noted above.

3.1.3.2 Riverine Cultural Subsystem

The riverine cultural subsystem identified in the Study Area is the canal, which is discussed below.

Canal

Canals are the aquatic community of either a manmade waterway or a natural stream channel modified for navigation or irrigation in which the gradient is typically low. Only one canal, the Erie Canal, is found within the Study Area. Typical fish in the canal include brook stickleback (*Culea inconstans*), central mudminnow (*Umbra limi*), brook silverside (*Labidesthes sicculus*), and pike (*Esocidae*).

Source: Ecology and Environment, Inc.

Intermittent stream running through a calcareous talus slope woodland community, Town of Lewiston.

3.1.4 Subterranean System

Within the subterranean system, air- and water-filled crevices and cavities create both aquatic and non-aquatic habitats. Hydrology, substrate characteristics, and light distinguish the various subterranean subsystems. One subterranean subsystem recorded along the Study Area is the natural cave subsystem.

3.1.4.1 Natural Caves Subsystem

The natural cave subsystem consists of caves and cavities that have not been modified by human activities (Edinger et al. 2002). Due to the lack of human impact, these caves are typically dominated by native biota.

Talus Caves

The only natural cave ecological community observed in the Study Area is the talus cave community, which is represented by small crevices and caves with walls formed by boulders that are in a talus slope near the bottom of a cliff. In northern New York, talus caves provide denning habitat that is ideal for species such as rattlesnakes, bobcat (*Lynx rufus*), North American porcupine (*Erethizon dorsatum*), and voles; however, of these species, only voles are expected to occur in this region of New York. Other organisms that use talus caves include bats, more specifically the eastern small-footed bat (*Myotis leibii*) and the big brown bat (*Eptesicus fuscus*) (see Section 3.2.3). While craneflies, spiders, lichens, and fungi are also believed to inhabit talus caves, Edinger indicates that more data are needed to determine species and regional variation (Edinger et al. 2002).

Source: Ecology and Environment, Inc.

A talus cave community type, Town of Lewiston.

Some sites within the Study Area have boulder clusters and features that were formed by the erosion of cliff and bedrock outcrops. These features exhibit narrow to wide cavities or small areas that are a few inches to several feet wide and extend from one to several feet into the cliff base or talus slopes. Cavities observed throughout the Study Area were variable in size and shape, with chambers wider than visible openings at the surface.

3.1.5 Threatened Botanical Species in Ecological Communities

A review of the NYNHP state-listed species in Niagara County shows 43 plant species that are considered threatened or of special concern that have been documented in the county. Some of these, however, may have been historically documented only once and not since. Thirty-four of these 43 species have a greater potential of occurring along the Niagara Escarpment. This assumption is based on knowledge of the ecology of Niagara County and the description of current geographic ranges provided by NYNHP, as shown in Table 3.1-11.

A review of the federal and state-listed botanical species considered threatened or endangered was compared with the plant lists from the field surveys (see Appendix D). No federally-listed threatened or endangered species were identified during 2013 Project field surveys; however, three state-listed threatened species were identified, including the big shellbark hickory (*Carya laciniosa*), smooth cliff brake (*Pellaea glabella*), and yellow giant hyssop (*Agastache nepetoides*) (USFWS 2012 and NYNHP 2010). Additionally, the pawpaw (*Asimina triloba*), a state-listed threatened species, has been identified on the Land Conservancy's Frank L. and Julia Dersham Young Niagara Escarpment Preserve but was not identified during Project field surveys. While the escarpment could have habitat suitable for additional threatened and endangered species, the presence of these species was not confirmed during the Project field surveys.

The Niagara Escarpment has been subjected to moderate to severe disturbance associated with agricultural, residential, and commercial land use that has modified native plant communities, hydrology, and surface geology (see Figures 3.7-1 and 3.7-2). Much of the Niagara Escarpment, however, is still relatively undisturbed, with natural areas that have been either minimally investigated or not surveyed to date. Habitat conditions, areas of undisturbed geology and hydrology, and micro-environments that could support other federal and state-listed plant species exist across the Niagara Escarpment.

Table 3.1-11 State-Listed Threatened or Endangered Plants Potentially Occurring in Niagara County

Common Name	Scientific Name	State Status
Big shellbark hickory*	*Carya laciniosa*	Threatened
Bushy cinquefoil	*Potentilla paradoxa*	Endangered
Coopers milkvetch	*Astragalus neglectus*	Endangered
Cork (rock) elm	*Ulmus thomasii*	Threatened
Drummond's rock-cress	*Boechera stricta* (Graham) Al-Shehbaz	Threatened
Elk sedge	*Carex garberi*	Endangered
Four-flowered loosestrife	*Lysimachia quadriflora*	Endangered
Giant (woodland) pine-drops	*Pterospora andromedea*	Endangered
Golden seal	*Hydrastis canadensis*	Threatened
Gypsy-wort (taperleaf water horehound)	*Lycopus rubellus*	Endangered
Lesser fringed gentian	*Gentianopsis virgata (Raf.) Holub ssp. virgata*	Endangered
Mountain death camas	*Anticlea elegans Pursh ssp. Elegans (aka Zigadenus elegans ssp. Glaucus)*	Threatened
Northern wild comfrey	*Cynoglossum virginianum var. boreale* (Fern.) Cooperrider	Endangered
Ohio goldenrod	*Oligoneuron ohioense*	Threatened
Pawpaw	*Asimina triloba*	Threatened
Rock-cress	*Draba arabisans*	Threatened
Rough avens	*Geum virginianum L.*	Threatened
Rough-leaf dogwood	*Cornus drummondii*	Endangered
Scarlet indian-paintbrush	*Castilleja coccinea*	Endangered
Shrubby St. John's-wort	*Hypericum prolificum*	Threatened
Shumard oak	*Quercus shumardii* Buckley	Endangered
Sky-blue aster	*Symphyotrichum oolentangiense*	Endangered
Slender blazing star	*Liatris cylindracea*	Endangered
Smartweed dodder	*Cuscuta polygonorum*	Endangered
Smooth bur-marigold	*Bidens laevis*	Threatened
Smooth cliff brake*	*Pellaea glabella*	Threatened
Stiff leaf goldenrod	*Oligoneuron rigidum*	Threatened
Swamp lousewort	*Pedicularis lanceolata*	Threatened
Swamp oats	*Sphenopholis pensylvanica*	Endangered
Troublesome sedge	*Carex molesta*	Threatened
Twin-leaf	*Jeffersonia diphylla*	Threatened
Wafer-ash	*Ptelea trifoliata ssp. trifoliata*	Endangered
Woodland bluegrass	*Poa sylvestris* A. Gray	Endangered
Yellow giant hyssop*	*Agastache nepetoides*	Threatened

Source: NYNHP 2010.

*Species was identified during 2013 Project field surveys.

3.2 Wildlife Resources

Although the Niagara Escarpment has been subjected to moderate to severe disturbance, it is relatively undisturbed compared with the surrounding areas, which are largely dominated by agricultural fields, vineyards, and private residences. The escarpment provides an important band of natural and unique habitat that serves as important habitat for wildlife resources. A review of the wildlife likely to use the habitats in the Study Area included publicly available studies as well as field observations of wildlife conducted for this Project.

3.2.1 Bird Resources

Birds present along the Niagara Escarpment that are likely to use the habitats in the Study Area were evaluated. The study included a review of publicly available studies as well as data collected from breeding bird surveys conducted for this Project.

3.2.1.1 Breeding Birds

In order to evaluate the potential for breeding birds within the Study Area, two major sources for breeding bird information were reviewed, the NYS Breeding Bird Atlas (NYSDEC 2007) and the USGS North American Breeding Bird Survey (Sauer et al. 2012). The existing studies were supplemented with a June 2013 breeding bird survey in the Study Area. The findings of the 2013 breeding bird survey are summarized below and the complete breeding bird field data are provided in Appendix E. A detailed description of breeding bird survey methodology is located in Appendix B.

In June 2013, breeding bird surveys were conducted at 17 of the 19 sites along the Niagara Escarpment. (Limitations in authorized access at the time of the surveys prevented surveyors from visiting every site.) Breeding bird surveys were conducted to document resident bird activity along the Niagara Escarpment during the peak breeding period of the year for most of the resident bird populations in the Study Area. The surveys were conducted by an avian specialist during the week of June 3, 2013. Up to four different sites were surveyed each day until all 17 breeding bird survey sites were surveyed. An avian specialist walked through the site documenting any species seen or heard within the boundaries of the site. All surveys occurred between one half-hour before sunrise and approximately 10:30 a.m., which is the period of time when birds are most active and vocal. Mobbing calls were used on each site at random locations to increase bird activity and thus increase the likelihood of positive identification of species present in the area. Survey sites were chosen based on variables such as proximity to the escarpment, land access, and habitat. Surveys were not conducted during non-conducive birding weather such as heavy rains, winds, or fog, when the detectability of birds within the survey areas would be compromised. In general, the majority of sites surveyed were dominated by deciduous forests and/ or agricultural fields or vineyards.

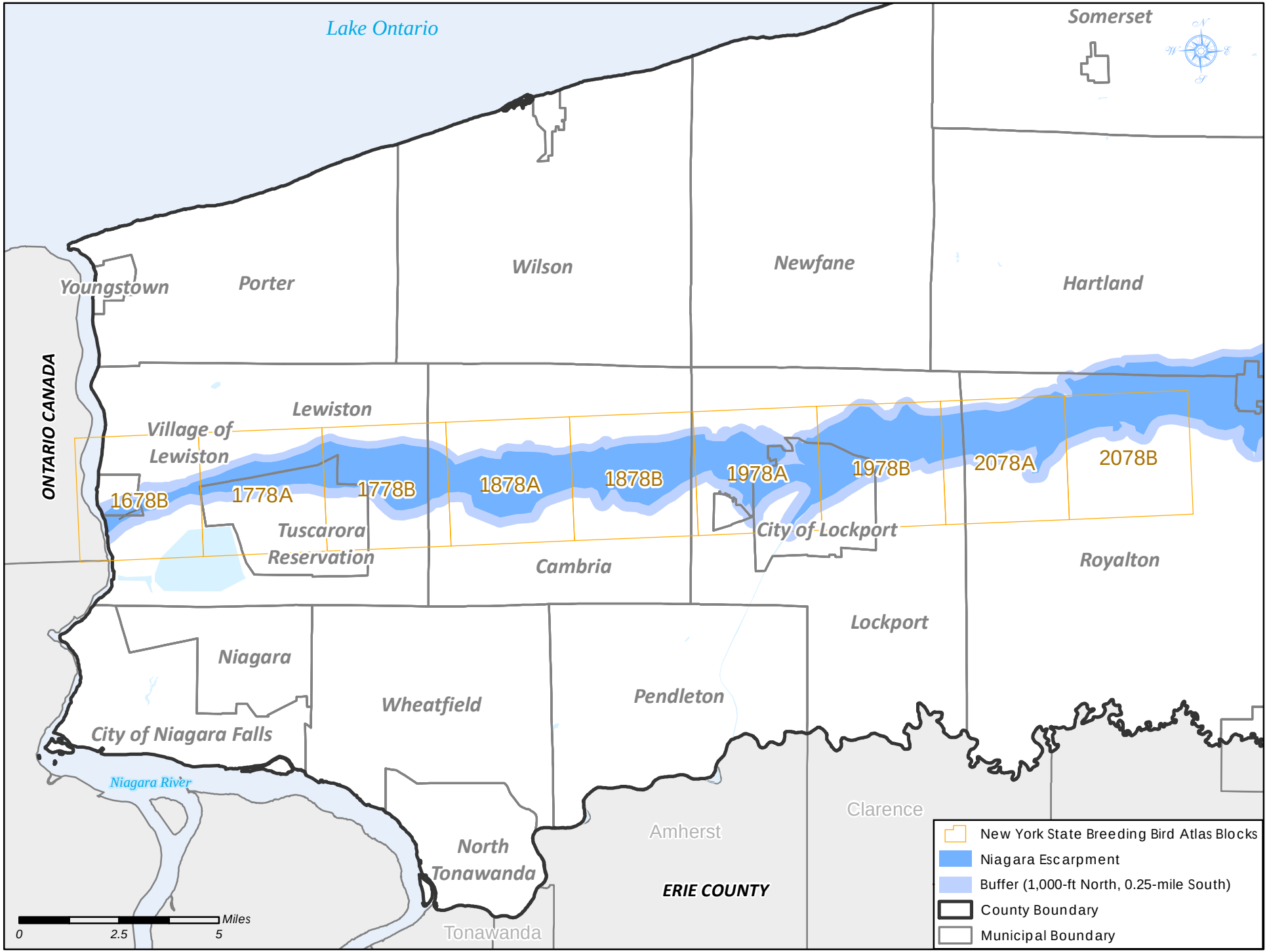
A total of 83 species were identified across the 17 breeding bird survey sites. As most of the sites were similar, deciduous-dominated, edge, and agricultural habitats, the species composition per site was generally similar across all 17 sites. However, several of the sites possessed noteworthy features such as large ponds, conifer stands, running streams, and extensive scrub/shrub habitat, which provided habitat for additional species and increased species diversity.

The most commonly identified species across all survey sites were American robin (*Turdus migratorius*), blue jay (*Cyanocitta cristata*), and northern cardinal (*Cardinalis cardinalis*), all of which were present at 17 of the surveyed 18 sites. Other common species (those occurring at 75% of the survey sites) were cedar waxwing (*Bombycilla cedrorum*), red-winged blackbird (*Agelaius phoeniceus*), yellow warbler (*Setophaga petechial*), American goldfinch (*Spinus tristis*), gray catbird (*Dumetella carolinensis*), red-eyed vireo (*Vireo olivaceus*), and red-bellied woodpecker (*Melanerpes carolinus*), all of which are considered common breeding species in the area and are known to use woodland and edge habitats such as those present throughout much of the Niagara Escarpment. The least common species for the Study Area, or those occurring at only a single site among the 17 surveyed, included black-billed cuckoo (*Coccyzus erythropthalmus*), blackburnian warbler (*Setophaga fusca*), black-throated green warbler (*Setophaga virens*), blue-headed vireo (*Vireo solitarius*), chestnut-sided warbler (*Setophaga pensylvanica*), Cooper's hawk (*Accipiter cooperii*), double-crested cormorant (*Phalacrocorax auritus*), golden-crowned kinglet (*Regulus satrapa*), grasshopper sparrow (*Ammodramus savannarum*), least flycatcher (*Empidonax minimus*), willow flycatcher (*Empidonax traillii*), common raven (*Corvus corax*), wood duck (*Aix sponsa*), yellow-bellied sapsucker (*Sphyrapicus varius*), northern mockingbird (*Mimus polyglottos*), and purple finch (*Haemorhous purpureus*). Many of these species are considered rare or uncommon in Niagara County, and species such as double-crested cormorant, common raven, and wood duck, which were identified flying over the survey areas, were likely passing through rather than actually using the site directly.

Breeding Bird Atlas

The New York State Breeding Bird Atlas (BBA) project was an extensive survey to determine the current distribution of breeding bird species in the state (NYSDEC 2007) (see Figure 3.2-1). The first atlas project was conducted between 1980 and 1985 (Andrle and Carroll 1988). Surveys for the Atlas 2000 project (2000 through 2005) allow a comparison with the results of the first atlas to see how the distribution of breeding birds has changed over time (McGowan and Corwin 2008). Volunteer birders recorded evidence of breeding bird species throughout the state within 5-kilometer by 5-kilometer blocks. The data provide evidence of breeding composition and, in general, the quality of breeding habitat. Depending on the breeding evidence observed, species were classified as possible, probable, or confirmed breeders.

Figure 3.2-1 New York State Breeding Bird Atlas Along the Niagara Escarpment Study Area



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Nine BBA blocks encompass the survey locations across Niagara County (see Table 3.2-1). Blocks 1978B, 2078A, and 1778B yielded the greatest number of bird species, with 77, 77, and 74 species, respectively. The overall average number of species per BBA block was 68.4 species, approximately 8 species fewer than the statewide goal of 76 species that indicate diversity.

Table 3.2-1 NYSDEC 2000 - 2005 Breeding Bird Atlas Results for Blocks Corresponding to the Niagara Escarpment in Niagara County

Block Number	Total Species	Breeding Status		
		Possible	Probable	Confirmed
1678B	73	6	37	30
1778A	65	8	35	22
1778B	74	9	27	38
1878A	59	16	22	21
1878B	59	11	25	23
1978A	67	10	33	24
1978B	77	14	47	16
2078A	77	10	37	30
2078B	65	12	24	29

Source: NYSDEC 2007

No federally listed threatened or endangered species were identified in any of these nine BBA blocks. Two species state-listed as threatened—pied-billed grebe (*Podilymbus podiceps*) and northern harrier (*Circus cyaneus*) —were identified in two of the BBA blocks investigated. The pied-billed grebe was identified as a "probable" breeder within block 1678B, and the northern harrier was identified as a "probable" breeder within block 1778A (NYSDEC 2013). Additionally, eight species of special concern were identified, including American bittern (*Botaurus lentiginosus*) (1678B), golden-winged warbler (*Vermivora chrysoptera*) (1778A, 1778B, and 1978A), cerulean warbler (*Setophaga cerulea*) (1778A, and 1778B), horned lark (*Eremophila alpestris*) (1978B, 2078A, and 2078B), vesper sparrow (*Pooecetes gramineus*) (2078A), grasshopper sparrow (2078A, and 2078B), sharp-shinned hawk (*Accipiter striatus*) (1678B, 1878A, 1978A, 1978B, and 2078A), and Cooper's hawk (1878A, 1978B, and 2078B). Although the pied-billed grebe and American bittern were identified in the BBA blocks in a portion of the Study Area, these species are not expected to breed within the Project area due to absence of suitable habitat.

USGS Breeding Bird Surveys

Breeding bird surveys (BBS) are conducted annually by volunteers during the peak nesting season (June) as part of a long-running, widespread monitoring program implemented by the USGS (Sauer et al. 2012). All birds heard or identified are documented using a specified protocol. Surveys are conducted for 3 minutes at 50 roadside locations, one-half mile apart, starting 30 minutes before sunrise. Birds detected by sight or sound are documented within a 0.25-mile

radius of each location. The BBS data provide a valuable source of information on bird populations and trends over time in given areas, both locally and nationally.

Two USGS breeding bird survey routes (St. Johnsburg and E. Youngstown) are in the immediate vicinity of the Niagara Escarpment (see Figure 3.2-2). The species identified on these breeding bird surveys (see Appendix E) are similar to those identified during the New York State BBA project and are generally consistent with regularly occurring nesting species for the region.

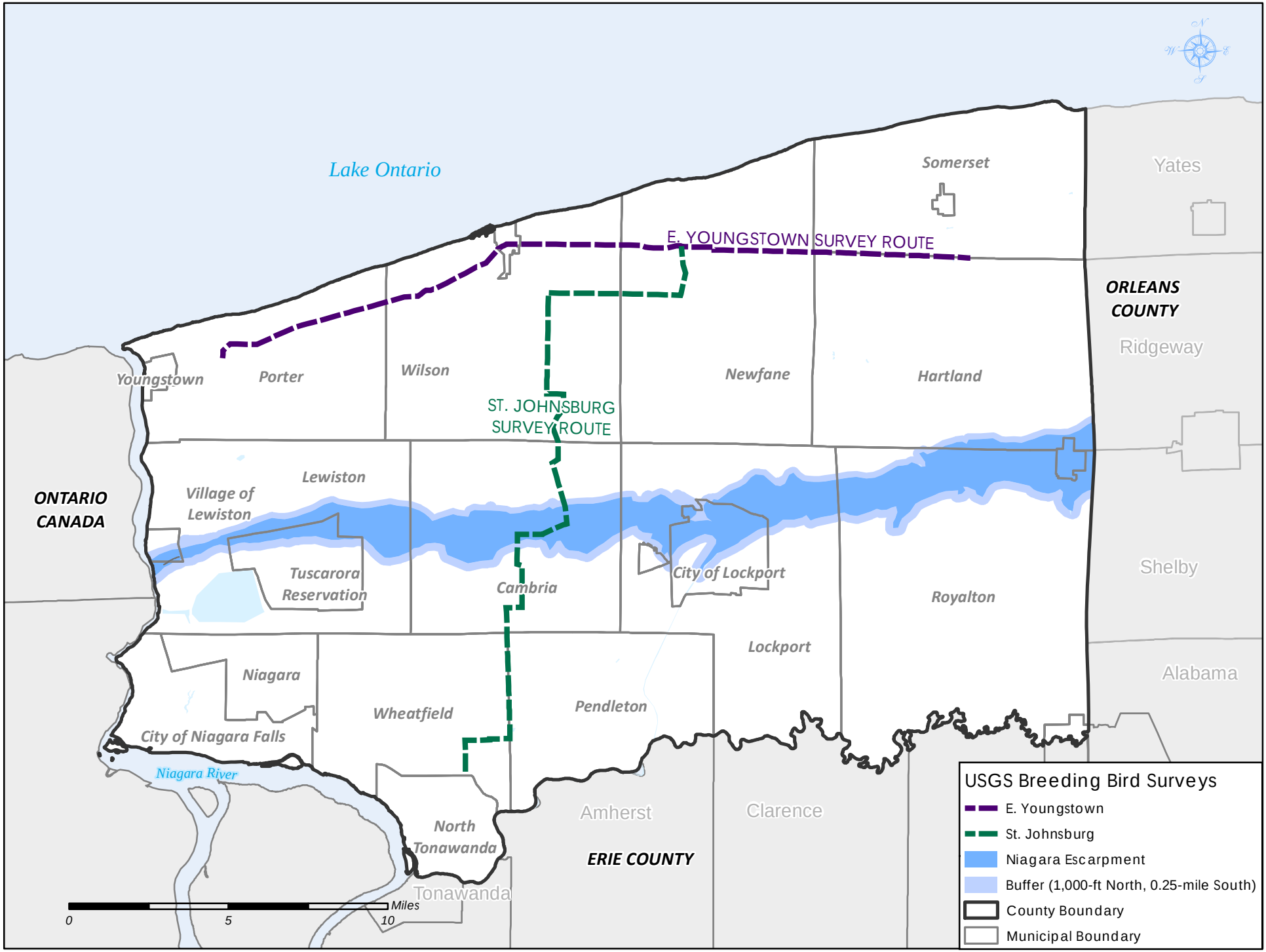
A total of 16 state-listed species were included among the species documented on these BBS routes. Table 3.2-2 identifies these species, the route on which they were identified, and the date of the last known occurrence. All of the state-listed threatened and species of special concern species have been documented in low numbers and some have not been identified in the past 30 or more years. No federally-listed threatened or endangered species were identified during these surveys.

Table 3.2-2 State-Listed Species Identified from the USGS BBS

Species	NYS Status	Date of Last Known Occurrence	Birds per Route	
			St. Johnsburg	E. Youngstown
Common nighthawk	Special Concern	1988/1992	0.03	0.04
Cooper's hawk	Special Concern	2005	-	0.07
Golden-winged warbler	Special Concern	1998/1994	0.05	0.04
Grasshopper sparrow	Special Concern	1981/1991	0.22	0.07
Henslow's sparrow	Threatened	1989	0.05	-
Horned lark	Special Concern	2012/2012	4.13	4.87
Northern harrier	Threatened	2001/2007	0.17	0.29
Osprey	Special Concern	1982	-	0.02
Pied-billed grebe	Threatened	1974	-	0.02
Red-headed woodpecker	Special Concern	2004/1979	0.13	0.04
Red-shouldered hawk	Special Concern	1981	-	0.04
Sedge wren	Threatened	1986	-	0.04
Sharp-shinned hawk	Special Concern	1999	0.08	-
Upland sandpiper	Threatened	1996/2001	0.13	0.47
Vesper sparrow	Special Concern	1989/2012	0.32	1.27
Yellow-breasted chat	Special Concern	1976	-	0.04

Source: Sauer et al. 2012.

Figure 3.2-2 USGS Breeding Bird Surveys in Proximity to the Niagara Escarpment Study Area



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3.2.1.2 Migratory Birds

Every year during the spring and fall seasons, migrating birds can be found throughout much of western and central New York State, particularly in areas of dynamic natural habitats and landscapes. Areas where large numbers of migratory birds often congregate for nourishment, safety, and roosting are known as stopover areas. In general, high quality stopover habitats are forested areas with dense understories that are far removed from human influence and disturbances such as cities, roads, and agriculture. Additional stopover habitats could include high-quality wetland complexes, streams, and ponds that are undisturbed by human activity.

The Great Lakes present difficulties for migrating birds because they are forced to go around them or fly over them, which passerines generally do. During spring migration, birds will often congregate in stopover habitats relatively close to the Great Lakes, building body reserves and waiting for favorable weather conditions before making the long strenuous flight over Lake Ontario (National Audubon Society 2013a). The Niagara Escarpment serves as a general spring stopover location for birds before crossing Lake Ontario; however, the main stopover location for migratory birds crossing Lake Ontario is located closer to the shoreline.

Although the forest cover along the escarpment is not contiguous, there are large stretches of forest cover on the Tuscarora Nation Territory in the Town of Lewiston (see Figure 3.6-1), with additional smaller patches of forest present in Cambria and Royalton. These habitats, although not contiguous and sometimes small, are an important spring stopover habitat for neotropical migratory bird species.

Migratory bird surveys were not conducted as part of this study, and studies of migratory bird populations specific to the Niagara Escarpment are lacking; however, various resources are available to interpret the potential for migratory activity within Niagara County (eBird 2013) and the New York State area south of Lake Ontario (Audubon 2012).

eBird Results

eBird is an online program developed by the Cornell Laboratory of Ornithology and the National Audubon Society that documents the presence or absence of bird species as well as bird abundance via user observational data across the world (eBird 2013). For this study, a search was made for bird species present during the usual periods of spring and fall migration for all of Niagara County. Resources for this search are limited in such a county-wide program, so the escarpment was not investigated separately from the rest of the county. However, based on the habitat types present along the escarpment and the bird species actually identified within Niagara County during migration, inferences can be drawn as to which migratory species could potentially use the escarpment (see Table 3.2-3). It is important to note that the eBird results document numerous other migratory species such as

waterfowl and shorebirds that would congregate along the Niagara River and Lake Ontario shoreline rather than on the escarpment.

Table 3.2-3 List of Representative Migratory Birds of Niagara County Potentially Occurring Along the Niagara Escarpment

Common Name	Scientific Name	Habitat
Bay-breasted warbler	*Dendroica castanea*	Woodlands
Black-billed cuckoo	*Coccyzus erythropthalmus*	Woodlands and thickets
Blackpoll warbler	*Dendroica striata*	Woodlands
Blue-headed vireo	*Vireo solitarius*	Woodlands
Cape May warbler	*Dendroica tigrina*	Woodlands
Fox sparrow	*Passerella iliaca*	Woodlands and thickets
Gray-cheeked thrush	*Catharus minimus*	Woodlands with thick understory
Hermit thrush	*Catharus guttatus*	Woodlands and woodland openings with dense understory
Magnolia warbler	*Dendroica magnolia*	Woodlands
Palm warbler	*Dendroica palmarum*	Woodlands and thickets
Pine siskin	*Carduelis pinus*	Open woodlands
Pine warbler	*Dendroica pinus*	Conifer stands
Ruby-crowned kinglet	*Regulus calendula*	Woodlands
Rusty blackbird	*Euphagus carolinus*	Woodlands
Swainson's thrush	*Catharus ustulatus*	Woodlands with thick understory
White-crowned sparrow	*Zonotrichia leucophrys*	Scrub/shrub
White-throated sparrow	*Zonotrichia albicollis*	Woodlands
White-winged crossbill	*Loxia leucoptera*	Conifer stands
Wilson's warbler	*Wilsonia pusilla*	Scrub/shrub
Yellow-bellied sapsucker	*Sphyrapicus varius*	Young forests and edge habitats

Source: eBird 2013

3.2.1.3 Threatened and Endangered Bird Species

Federal and state-listed threatened and endangered species of birds were reviewed. No federally listed threatened or endangered birds are known to regularly occur in Niagara County. However, combining in-field results from the breeding bird surveys with the results from the NYSDEC BBA and USGS BBS, a total of 18 state-listed threatened or species of special concern were identified as occurring in Niagara County and, therefore, potentially within the Study Area. Of these species, three species of special concern (Cooper's hawk, vesper sparrow, and grasshopper sparrow) were identified during the 2013 breeding bird surveys. The Cooper's hawk and grasshopper sparrow were identified only once; the vesper sparrow was identified at two sites in the Study Area. A list of these species and their state status is provided in Table 3.2-4.

Table 3.2-4 State-Listed Species Potentially Occurring in Niagara County

Species	NYS Status	BBA 2000-2005	USGS BBA	2013 Niagara Escarpment BBS
American bittern	Special Concern	X		
Cerulean warbler	Special Concern	X		
Common knighthawk	Special Concern		X	
Cooper's hawk	Special Concern	X	X	X
Golden-winged warbler	Special Concern	X	X	
Grasshopper sparrow	Special Concern	X	X	X
Henslow's sparrow	Threatened		X	
Horned lark	Special Concern		X	
Northern harrier	Threatened		X	
Osprey	Special Concern		X	
Pied-billed grebe	Threatened		X	
Red-headed woodpecker	Special Concern		X	
Red-shouldered hawk	Special Concern		X	
Sedge wren	Threatened		X	
Sharp-shinned hawk	Special Concern	X	X	
Upland sandpiper	Threatened		X	
Vesper sparrow	Special Concern	X	X	X
Yellow-breasted chat	Special Concern		X	

Source: NYSDEC 2007; Sauer et al. 2012.

Audubon Watch List and NYS Species of Greatest Conservation Need

In order to identify any additional species that may be of concern but are not federally or state-listed, the 2007 Audubon Watch List and the NYS Species of Greatest Conservation Need (SGCN) were also reviewed. The 2007 Audubon Watch List is a list of America's most imperiled bird species and is based on research from the bird conservation community along with citizen science data from the Christmas bird counts and annual breeding bird surveys (National Audubon Society 2013b). The NYS SGCN list for birds is based on federally and state-listed threatened and endangered species as well as species that have fewer than 20 occurrences in the NYS Natural Heritage Program database (NYSDEC 2013). Table 3.2-5 identifies species that were both identified during field surveys and are on either the Audubon Watch List or the NYS SGCN list.

Audubon Watch List

Results of the Niagara Escarpment breeding bird surveys were cross-referenced with the 2007 Audubon WatchList, which currently lists 176 bird species in the continental United States (National Audubon Society 2013b). Two bird species on the 2007 Audubon WatchList were identified during the breeding bird surveys: the blue-winged warbler (*Vermivora cyanoptera*) and the wood thrush (*Hylocichla mustelina*). Both these species were identified multiple times across

multiple field sites along the escarpment. The identification of these species during these surveys indicates that they are actively breeding in Study Area habitats.

Table 3.2-5 Special Concern Bird Species Identified During the Niagara Escarpment Breeding Bird Surveys

Species	State Status	2007 Watch List	NYS SGCN
Blue-winged warbler	-	X	X
Bobolink	-		X
Cooper's hawk	Special Concern		X
Eastern meadowlark	-		X
Grasshopper sparrow	Special Concern		X
Scarlet tanager	-		X
Vesper sparrow	Special Concern		X
Wood thrush	-	X	X

Source: NYSDEC 2013a

NYS Species of Greatest Conservation Need

Results of the breeding bird surveys were cross-referenced with the NYS SGCN. A total of 118 bird species are currently listed on the SGCN list; eight of the listed species were identified at least once during the Niagara Escarpment breeding bird surveys: blue-winged warbler, bobolink (*Dolichonyx oryzivorus*), Cooper's hawk, eastern meadowlark (*Sturnella magna*), grasshopper sparrow, scarlet tanager (*Piranga olivacea*), vesper sparrow, and wood thrush.

All of these species were identified at least twice during the surveys, except for Cooper's hawk and grasshopper sparrow, which were both identified only once. Identification of these species during these surveys indicates that they are actively breeding in the Study Area.

3.2.2 Amphibians and Reptiles

Specific field surveys for amphibians were made in order to evaluate the health of the ecosystems, as these species are very sensitive to changing water and air quality. In order to evaluate the status and distribution of the amphibians and reptiles within the Study Area, the New York State Amphibian and Reptile Atlas Project (Herp Atlas), a 10-year survey by NYSDEC to document the geographic distribution of New York State's herpetofauna (amphibians and reptiles), was reviewed (Gibbs et al. 2007). A detailed description of field survey methodology is located in Appendix B. A summary of the findings is presented below.

3.2.2.1 Amphibians

Amphibian field surveys were conducted in April 2013 in wetland and vernal pool habitats to determine the presence or absence of frogs, toads, and salamanders. Amphibians have complex life cycles and specific breeding requirements in spring and early summer that make them sensitive to changes in the specific habitats that they need for food, reproduction, and shelter. They are reliable

indicators of water quality since they require aquatic habitats for reproduction and they are directly affected by changing water levels and water quality brought on by weather, climate, and human uses. Disturbances from roads, trails, traffic, fires, logging, and water chemistry can affect the ability of amphibian species to survive even in areas with ideal hydrology and wetland habitat.

Review of the Herp Atlas identified ten salamander species and nine frog and toad species located in the vicinity of the Study Area (see Table 3.2-6). Of these species, five salamander species were identified along with five frogs and one toad species during the spring 2013 field surveys. The field surveys did not identify any new species that were not identified in the Herp Atlas.

Table 3.2-6 Amphibian Species with Known Occurrences in Niagara County

Common Name	Scientific Name	NYS Species of Concern	Identified During Surveys
Salamander Species			
Allegheny Mountain dusky salamander	*Desmognathus ochrophaeus*		
Blue-spotted salamander	*Ambystoma laterale*	X	X
Common mudpuppy	*Necturus maculosus*		
Four-toed salamander	*Hemidactylium scutatum*		
Northern dusky salamander	*Desmognathus fuscus*		X
Northern red-backed salamander	*Plethodon cinereus*		X
Northern slimy salamander	*Plethodon glutinosus*		X
Northern two-lined salamander	*Eurycea bislineata*		
Red eft (Eastern newt)	*Notophthalmus viridescens*		
Red-spotted newt	*Notophthalmus viridscens*		
Spotted salamander	*Ambystoma maculatum*		X
Frog and Toad Species			
Bullfrog	*Rana catesbiana*		X
Eastern American toad	*Bufo americanus*		X
Gray treefrog	*Hyla versicolor*		X
Green frog	*Rana clamitans*		X
Northern leopard frog	*Rana pipiens*		X
Northern spring peeper	*Pseudacris crucifer*		X
Pickerel frog	*Rana palustris*		
Western chorus frog	*Pseudacris triseriata*		
Wood frog	*Rana sylvatica*		

Source: Gibbs et al. 2007.

3.2.2.2 Reptiles

A review of the Herp Atlas indicated seven species of snake and four species of turtles are known to occur in the Study Area (see Table 3.2-7) (NYSDEC 2013d). There are no federally listed or state-listed threatened or endangered reptile species that are known to occur in Niagara County. The only species confirmed during the field surveys was the common garter snake (*Thamnophis sirtalis*).

Table 3.2-7 Reptile Species with Known Occurrences in Niagara County

Common Name	Scientific Name
Snakes	
Black rat snake	*Elaphe o. obsolete*
Common garter snake	*Thamnophis sirtalis*
Eastern milk snake	*Lampropeltis t. triangulum*
Northern brown snake	*Storeria d. dekayi*
Northern redbelly snake	*Storeria o. occipitomaculata*
Northern water snake	*Nerodia s. sipedon*
Smooth green snake	*Liochlorophis vernalis*
Turtles	
Common snapping turtle	*Chelydra s. serpentine*
Painted turtle	*Chrysemys picta*
Red-eared slider turtle	*Trachemys scripta*
Wood turtle	*Clemmys insculpta*

Source: Gibbs et al. 2007

3.2.2.3 Threatened and Endangered Amphibian and Reptiles

There are no federally listed or state-listed threatened and endangered amphibian or reptile species whose known range is in the Study Area (NYSDEC 2013f). However, there is one state-listed species of concern, the blue-spotted salamander, which was identified during spring amphibian surveys.

3.2.3 Bats

New York State is home to nine bat species (Stegemann et al. 2008), of which all but one are likely to or could use habitat in the Niagara Escarpment Study Area (see Table 3.2-8). These bats are either tree bats or cave bats. Tree bats live year-round in trees, requiring them to migrate south of New York State during the cold winter months. Cave bats spend the winters hibernating in caves or mines, while their summer roosts include a variety of locations such as bridges, buildings, rock crevices, beneath loose bark, or in cracks or crevices in trees. It should be noted that while there are bat species that live in caves year-round, all of the cave bats found in New York State would only use caves or mines along the escarpment for hibernation.

On-site field surveys for bats were not conducted for this Project; however, the results of this desktop assessment provide a general understanding regarding the potential presence of individual bat species based on known distributions as well as habitats used by the species and habitats identified during field surveys in the Study Area. The review indicated seven bat species that, based on known range and habitat, are likely to be present in the Study Area, and one species that is potentially present within the Study Area. The known distribution and population of the big brown bat in Niagara County suggests it would be the most common bat in the Study Area.

Table 3.2-8 Bats of New York State

Common Name	Scientific Name	Federal Status	State Status	Known Range in NYS	Abundance within Range	Likely Present within the Study Area
Tree Bat Group						
Eastern red bat	*Lasiurus borealis*	NL	NL	Entire NYS	Uncommon to Rare	Yes
Hoary bat	*Lasiurus cinereus*	NL	NL	Entire NYS	Uncommon to Rare	Yes
Silver-haired bat	*Lasyionicterius noctivagans*	NL	NL	Entire NYS	Uncommon to Rare	Yes
Cave Bat Group						
Big brown bat	*Eptesicus fuscus*	NL	NL	Entire NYS	Common	Yes
Eastern small-footed bat	*Myotis leibii*	Under Review[1]	Special Concern	NYS except Long Island	Least Common in NYS	Potentially
Indiana bat	*Myotis sodalis*	Endangered	Endangered	NYS, no known occurrences in Niagara, Erie, Genesee, Wyoming counties	Uncommon	No
Little brown bat	*Myotis lucifugus*	NL	NL	Entire NYS	Common (before onset of white nose syndrome)	Yes
Northern long-eared bat	*Myotis septentrionalis*	Under Review[1]	NL	Entire NYS	Locally abundant to uncommon/ absent	Yes
Tricolored bat	*Perimyotis subflavus*	NL	NL	Entire NYS	Common	Yes

Source: Stegemann et al. 2008.

[1] Although these species are not officially listed as "Proposed" or "Candidate" species, it was stated in the Federal Register that sufficient data are present to warrant an official review of these species. To date, no official announcement has been made (50 CFR Part 17).

Key:
NL = not listed

85

The talus slopes and caves occurring along the escarpment have not been well-studied in terms of potential bat hibernacula, i.e., the location where bats hibernate during winter. The nearest known hibernaculum is an old mine in the Village of Akron in Erie County. It is possible that the caves in the escarpment are of sufficient size to support an environment where temperature and humidity regimes are conducive to bat hibernation. In the future, acoustical surveys at the cave entrances could be conducted to determine if any of these fissures or caves are acting as hibernacula, following up on any positive acoustical sites with mist netting.

3.2.3.1 Threatened and Endangered Bat Species

There are no species of bat currently on the federal threatened and endangered list that are likely to occur within the Study Area. However, two species of bats, the eastern small-footed bat (currently a state-listed species of special concern) and the northern long-eared bat, are likely to be present in the Study Area and are currently being considered for federal protection under the Endangered Species Act (ESA).

Talus slopes, which are a preferred roosting habitat of the eastern small-footed bat, are present along the escarpment, presenting an excellent opportunity to identify additional populations for this state-listed species of concern.

3.2.3.2 White-nose Syndrome (WNS)

WNS was first documented on hibernating bats in a single cave in Schoharie County, New York, in February 2006 (USFWS 2013a). Defined as a disease, WNS is named for the presence of a white fungal growth around the affected bats' muzzle, ears, and wing membranes (Blehert et al. 2009). Since 2006, it has been confirmed in 22 states, including New York, and five Canadian provinces, with the largest population impacts occurring in the northeastern United States (USFWS 2013a). WNS symptoms have been reported but not yet confirmed in four additional states.

The fungus is currently known to affect seven species of bat: big brown bat, eastern small-footed bat, gray bat (*Myotis grisescens*), Indiana bat, little brown bat, northern bat (*Eptesicus nilssonii*), and the tri-colored bat (all cave bats), all with hibernating, wintering strategies. To date, no tree bats have been confirmed as being affected by this disease (USFWS 2013a). Nationally, a population decline of more than 75% has been observed at surveyed hibernacula from 2006 through 2007 (Blehert et al. 2009). In New York State the declines have been much more severe; observed statewide population declines due to WNS include 98% of northern long-eared bats, 95% of tri-colored bats, 90% of little brown bats, 71% of Indiana bats, and 13% of eastern small-footed bats (NYSDEC 2012). If the current infection and mortality trend continues, the little brown bat could become extinct in the next 20 years in the northeastern United States (Frick et al. 2010).

As a result of WNS, populations of cave bats are declining in New York State, and with the potential extinction of the little brown bat, it is essential that known bat habitat on the Niagara Escarpment be more thoroughly researched. Further efforts to identify and preserve specific habitat will help to maintain bat populations in the region.

3.3 Invasive Species

Invasive species are species of flora or fauna that are non-native and that adversely impact the native species within an ecological community. These non-native invasive species can cause significant damage if allowed to flourish because they deprive native species of nutrients, light, space, food, or water. Invasive plant species often occur in areas of significant disturbance; however, areas of extensive biodiversity can also be impacted by invasive species. Typical characteristics of an invasive species include the following:

- Fast growth
- Rapid reproduction
- High dispersal rate
- Ability to adapt to changing conditions
- Tolerance of a wide range of environmental conditions
- Ability to live off a wide range of food types
- Association with human activities.

The negative effects of invasive species go beyond limiting the biodiversity of ecosystems through competition with native species. These rapidly spreading plants can cause decreases in both agricultural and forestry production. They can affect recreation and tourism, and they require large expenditures of federal, state and local tax dollars to control and eradicate them.

3.3.1 Invasive Vegetation

Invasive plants represent a serious threat to the biological integrity of all habitats associated with the Niagara Escarpment. Spring ephemeral plants and their communities are the most vulnerable to competition from invasive species. The growth period of many of these herbaceous, native plants occurs in full sun exposure in early spring before native tree and shrub leaf-out. Reproductive cycles depend on adequate sunlight and soil moisture conditions characteristic of early spring in Western New York. Growth cycles of these plants are nearly complete when tree canopy shades the forest floor. If invasive species use much of the available early-season sunlight and moisture, the native species begin to fail. Table 3.3-1 lists invasive plant species found during the field surveys that represent stressors on community health, recruitment, and natural succession of native spring ephemeral plant species.

Table 3.3-1 Invasive Plant Species Identified in 2013 Project Field Surveys

Common Name	Scientific Name	Origin	Description	Management Methods
Garlic mustard[1]	*Alliaria petiolata*	• Native to Europe, Asia	• Biennial • Produces average of 600 seeds per plant • Basal rosette first year; stalk forms 2nd year • Forms dense stands • Releases chemicals that hinder growth of neighboring plants	• Hand-pulling prior to seed formation for 5 years
Common reed[1]	*Phragmites australis*	• Introduced from Europe in the late 18th or early 19th century in ship ballast	• Perennial grass • Up to 15 feet tall • Flowers are purple to gold branched panicles • Forms dense monocultures • Runners (stolons) grow to 43 feet from parent • Each plant can produce 1,000s of seeds per years	• Plant competing species • Reduce nutrient load • Repeated mowing • Manipulate water level to inhibit growth • Herbicides • Burning
Multiflora rose[1]	*Rosa multiflora*	• Native to eastern China, Japan, and Korea • Introduced to North America from Japan in 1866	• Vigorous perennial shrub • Forms extensive thickets • Flowers are fragrant white to pink clusters • Each cane can produce up to 75,000 seeds, which are viable in soil up to 20 years • Roots can re-sprout • Stem tips can root	• Hand-pulling • Herbicides (glyphosate or triclopyr) • Biological- rose rosette disease

Table 3.3-1 Invasive Plant Species Identified in 2013 Project Field Surveys

Common Name	Scientific Name	Origin	Description	Management Methods
Bush honeysuckles[1]	*Lonicera tartarica, L. morrowii*	• *L. tatarica* is native to Central Asia and S. Russia and was introduced to North America for ornamental purposes in the1750s • *L. morrowii* is native to Japan and was imported to Massachusetts in the 1860s	• Perennial woody shrubs with hollow stems • 6 to 15 feet in height • Escape cultivation • Spread by birds • Form dense populations that outcompete and suppress the growth of native plant species	• Control should be started in late summer or early fall before seeds are ready to be dispersed • Hand-pulling of small clusters • Herbicides • Burning
Purple loosestrife[2]	*Lythrum salicaria*	• Native to Eurasia • Introduced to North America in early 1800s in ballast	• Hardy perennial herb • Flowers are purple spikes • Absence of natural enemies in North America • Can hybridize with native loosestrife • Re-sprouts from stem and rootstock cuttings	• Cutting followed by flooding so that cut plant stalks are completely immersed • Hand-pulling small populations • Herbicides (glyphosate) • Mowing, burning, and flooding are mostly ineffective • Biological control by insects

Table 3.3-1 Invasive Plant Species Identified in 2013 Project Field Surveys

Common Name	Scientific Name	Origin	Description	Management Methods
Reed canary grass[3]	*Phalaris arundacea*	• Native to Eurasia • Some debate on whether it is native to Pacific Northwest United States	• Perennial, cool-season, rhizomatous grass • 2 to 9 feet tall • Flat, rough, tapering leaves 3.5 to 10 inches long • Hairless erect stems • Compact panicles 3 to16 inches long • Flowers are green to purple early in season, later turning beige • Thick rhizome system that dominates soil subsurface • Forms dense monocultures	• Digging, hand-pulling small patches • Mowing, cutting • Tillage • Flooding and tillage • Burning • Shade clothing • Grazing (in combination with other methods) • Aquatic safe herbicides • Competition

Source:
[1] Cornell Cooperative Extension Invasive Species Program n.d [b].
[2] USDA NRCS, Fact Sheets & Plant Guides, Purple Loosestrife n.d.
[3] Evans n.d.
Images are from respective references.

Field data collected were limited to qualitative data on the presence and relative abundance of invasive plants in the Study Area. Their occurrence and density in or near sensitive habitats, however, provides invaluable information for landowners and natural resource managers wanting to develop effective control and management strategies while populations are small. Some sites were free of the invasive plant species of concern (listed in Table 3.3-1). Portions of some sites were only minimally affected, but many sites were impacted to a greater extent. The most severe damage observed involved the colonization of invasive plants as the result of soil and landscape disturbances. Disturbances are the primary cause of noxious weed and invasive plant recruitment into natural areas and sensitive habitats.

3.3.2 Invasive Insects

Invasive species can modify complex ecosystem interactions and lead to widespread loss of native species. High-impact invasive species of insects documented in New York State include the emerald ash borer (*Agrilus planipennis*) and the Asian longhorned beetle (*Anoplophora glabripennis*). Between 1996 and 2009, New York City and Long Island alone spent between $13 and $40 million annually because of the emerald ash borer infestation (New York Sea Grant 2011). While field surveys did not focus on the identification of invasive species insects, future attention to their presence and subsequent impact along the Niagara Escarpment is critical to its economic and ecological livelihood. More specifically, plant surveys documented the existence of many white and green ash trees within the Study Area, which are the targeted species of emerald ash borer. The Asian longhorned beetle affects other common trees, including maples, willows, and poplars, also documented during 2013 field surveys.

3.4 Geologic Resources

3.4.1 Bedrock Associated with the Escarpment

The bedrock of the Niagara Escarpment formed more than 400 million years ago when marine deposits of sand, clay, and mud, along with decayed tissues and skeletal remains of marine organisms, created layers of sedimentary rock of sandstone, limestone and shale, with a cap of hard dolomite rock. The escarpment was formed after tectonic activity tilted the bedrock, exposing it to erosion by water, weather, and glaciers. These geological activities occurred over millions of years, resulting in the erosion of the softer sandstone and shale rock and leaving overhanging ledges of dolomite that occasionally collapsed. This sequential process of erosion and collapse, dominated by the resistant layers of dolomite rock, has caused the face of the escarpment to retreat many miles southward to the location where we see it today.

Approximately 12,000 years ago, the retreat of the most recent Wisconsin glacier left behind numerous lakes and streams, including Lake Algonquin, Lake Warren, Lake Iroquois, and Lake Tonawanda. Lake Tonawanda was a shallow lake perched atop of the Niagara Escarpment. The glacial retreat was the most recent

geologic event that exposed the rock layers to significant erosion of the softer sandstone, limestone, and shale rock, leaving behind the more resistant layers of dolomite (Lockport Group) rock forming the cap rock (see Figure 3.4-1). This geologic activity resulted in the formation of Niagara Falls and the Niagara gorge. A detailed description of the geologic formation of the Niagara Escarpment is provided in Appendix G.

The resulting escarpment forms a ridge of rock that is at times 150-feet high and that extends approximately 750 miles, beginning in the east in western New York, forming the precipice that created Niagara Falls, and continuing through Ontario, Michigan, and Wisconsin (see Figure 1.1-1).

Various types of bedrock are associated with the Niagara Escarpment. Bedrock throughout the area is composed of Silurian age (435 to 410 million years ago) and Devonian age (410 to 360 million years ago) rocks (see Figure 3.4-2). The Queenston shale forms the base of the bedrock in the vicinity of the Niagara Escarpment. Ordovician in age, the Queenston shale is a red shale that is part of the Richmond Group (Brett et al. 1995). The various rock formations found on the Niagara Escarpment have been deposited as sediments in varying depths of water and thus vary in thickness, texture, color, etc. between locations. Additionally, some formations were truncated by erosion before other sediments were deposited; therefore, not all formations are present along the entire escarpment.

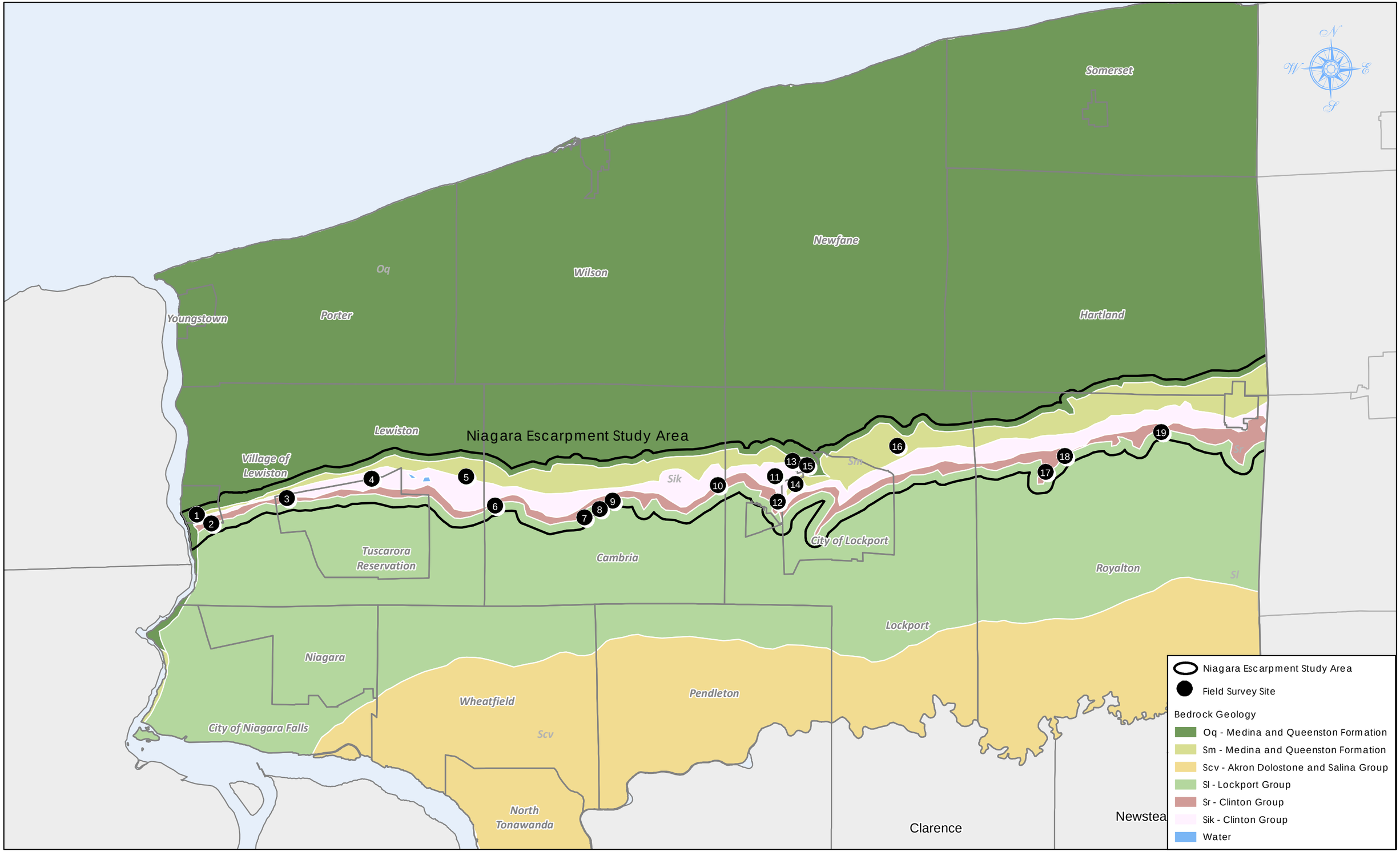
Lockport Group

The Lockport Group is composed of the following formations: Guelph dolomite, Eramosa dolomite, Goat Island dolomite, and Gasport dolomite (youngest to oldest). The Lockport group generally consists of massive- to medium-bedded argillaceous dolomite with minor amounts of dolomitic limestone and shale. Since these formations are most resistant to weathering, they make up the most prominent portions of the escarpment (Brett et al. 1995).

Formation	Description
Guelph dolomite	Medium-gray to dark-gray, light-gray to tan weathering, laminated, fine-grained, commonly oolitic dolomite
Eramosa dolomite	Consists of massive, pale brownish-weathering, vuggy, commonly biostromal dolomite.
Goat Island dolomite	Divided into three members: (1) Niagara Falls Member (2) Ancaster Member and (3) Vinemount Member
Gasport dolomite	Divided into two members: (1) Gothic Hill Member and (2) Pekin Member

Source: Brett et al. 1995; USGS 2013.

Figure 3.4-1 Bedrock Geology within the Niagara Escarpment Study Area - Niagara County, New York



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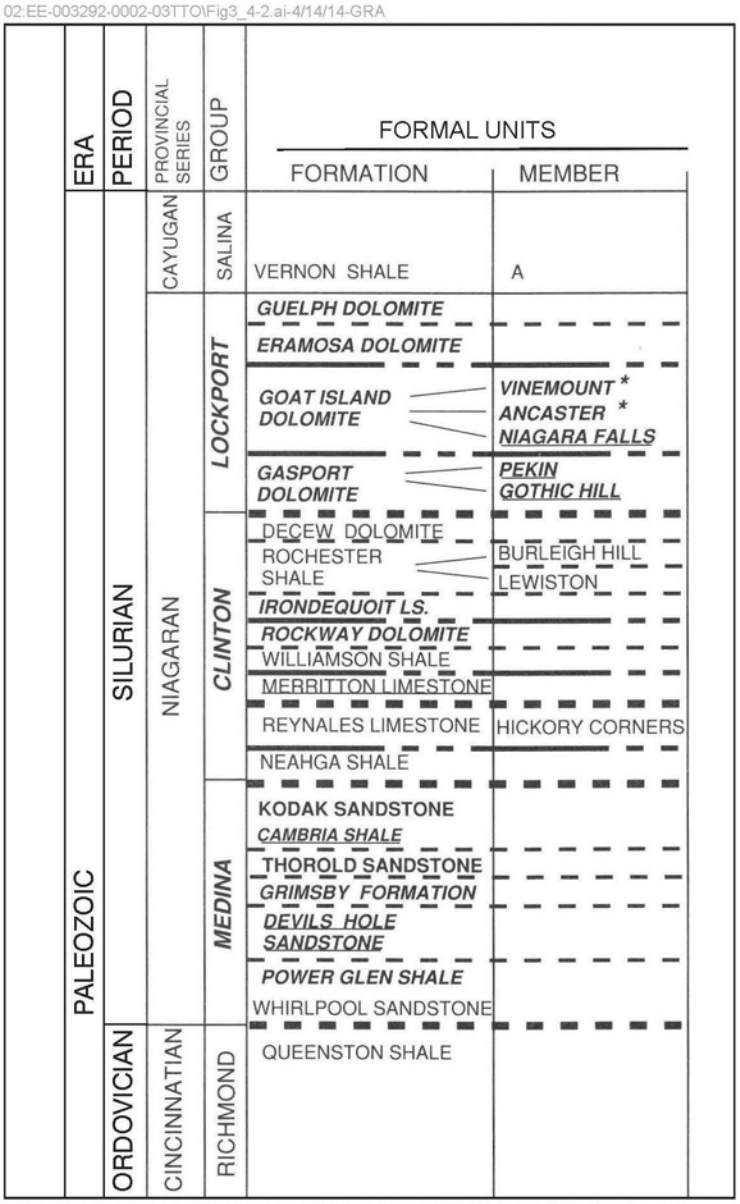


SOURCE: Adapted from U.S. Geological Survey Bulletin 2086 *Revised Stratigraphy and Correlations of the Niagaran Provincial Series (Medina, Clinton, and Lockport Groups) in the Type Area of Western New York,* 1995.

KEY:

Minor Unconformity

Major Unconformity

NOTE:
IRONDEQUOIT LS refers to IRONDEQUOIT LIMESTONE

Figure 3.4-2 General Stratigraphy of the Niagara Region

Clinton Group

The Clinton group is composed of the following formations: DeCew dolomite, Rochester shale, Irondequoit limestone, Rockway dolomite, Williamson shale, Merritton limestone, Reynales limestone, and Neahga shale (youngest to oldest). The Clinton Group consists primarily of thin- to medium-bedded shale, limestone, and dolomite (Brett et al. 1995).

Formation	Description
DeCew dolomite	Variably bedded, dark-gray to olive-gray, argillaceous to sandy, fine-grained dolomite that locally contains shale partings and interbeds. A middle bed of dolomitic shale up to 3 feet thick is present in the southern Niagara River Gorge
Rochester shale	Medium-dark gray to black calcareous mudstone with thin interbeds of calcareous to dolomitic calcisiltite and calcarenite. The Rochester Shale is divided into two members: (1) Lewiston Member (2) Burleigh Hill Member
Irondequoit limestone	Thick-bedded to massive, medium greenish-gray to pinkish-gray, buff-weathering, dolomitic, crinoidal- and brachiopod-rich packstone to grainstone
Rockway dolomite	Dense to compact, fine-grained, buff to gray dolomite that weathers buff. It is massive with a few thick dolomitic shales throughout
Williamson shale	Greenish-gray to black, fissile to slate, graptolite-bearing shale
Merritton limestone	Medium crystalline, buff weathering, gray to buff argillaceous limestone. It is thin-bedded with thin shale partings common. Glauconite and pyrite are abundant.
Reynales limestone	Thin-bedded, dark-gray, bioclastic, argillaceous limestone with shale partings
Neahga shale	Soft, slightly silty, calcareous gray to green shale

Source: Brett et al. 1995; USGS 2013.

Medina Group

The Medina group is composed of Kodak sandstone, Cambria shale, Thorold sandstone, Grimsby formation, Devils Hole sandstone, Power Glen shale, and Whirlpool sandstone (youngest to oldest). The Medina Group generally consists of white, green, and red, barren to moderately fossiliferous sandstone, siltstone, and shale that were deposited in deltaic and shallow marine environments (Brett et al. 1995).

Formation	Description
Kodak sandstone	Medium-gray to white, argillaceous, quartzose sandstone.
Cambria shale	Red to reddish-green, sparsely fossiliferous, interbedded sequence of shale, siltstone, and fine-grained sandstone.
Thorold sandstone	Consists of two laterally correlative facies: (1) mottled pink to red, cross-bedded, channel sandstone with trace fossils (2) it is a light-gray to white, quartzose sandstone to siltstone.
Grimsby Formation	Interbedded red to green sandstone, siltstone, and shale; divided into three main zones.
Devils Hole sandstone	Quartzose sandstone with some laminations, some interbedded shale; sets of storm beds are common throughout.
Power Glen shale	In the lower portions, dark gray shales with a few thin calcareous siltstones. In the upper portions it has a greenish cast.
Whirlpool sandstone	Medium- to thick-bedded, very light gray to white pure quartzose sandstone with scarce inclusions of flat pebbles of green shale. It is medium- to coarse-grained.

Source: Brett et al. 1995; USGS 2013.

3.4.2 Surficial Geology

Surficial deposits within the Niagara region (Figure 3.4-3) are the most recent depositions and were formed over the last 65 million years during the Cenozoic Era (Broughton et al. 1966). The most recent surface features are the result of glacially influenced topography, such as bodies of unsorted debris (glacial till) that formed along the margin of a glacier (moraines) and post-glacial weathering over the last 12,000 years.

The Niagara Escarpment is bordered to the north by the Ontario Plain (Ontario Lowlands) and to the south by the Tonawanda Plain. The Ontario Plain is a relatively flat lowland extending from the shore of Lake Ontario to the Niagara Escarpment. The Tonawanda Plain extends from the Niagara Escarpment to the Onondaga Escarpment and is a flat, poorly drained lowland (Tesmer 1981). These areas are also marked by several areas of east-west oriented terminal moraines or beach deposits (Niagara River Greenway Commission 2007).

Types of surficial deposits that exist within the Study Area include lacustrine beach deposits; lacustrine sand, silt, and clay; till, moraine, glacial erratics, and kame deposits; and detached bedrock. Lacustrine deposits are produced from stratified geologic material deposited in lakes. Till, moraine, glacial erratics, and kame deposits result from direct or indirect action of a glacier or glacial ice.

Field verification of the desktop geology was conducted at 10 of the 19 sites. The findings of these visits were consistent with the desktop studies. A similar escarpment-type landscape was seen at most locations. Site 17 (Royalton Ravine Park) did have some differences in landscape where the East Branch of Eighteen Mile Creek has eroded the escarpment, creating a ravine. The height and steepness of the escarpment varied slightly at each site due to erosion and the presence of different rock formations. Additionally, historical mining sites along the escarpment often altered the geological landscape (see Section 3.7.4.2 for further discussion on mining).

Source: Ecology and Environment, Inc.

Close-up of crinoid fossils (stems and stem fragments) found along the Niagara Escarpment, Town of Lockport.

3.4.3 Paleontological Resources

Numerous types of fossils can be found within the Silurian Age rocks of Niagara County. During the Silurian period, the area that is now the Niagara Escarpment was primarily a marine environment, ranging from near-shore environments to warm, shallow seas, to deeper marine environments. Fossils found include invertebrates from marine, beach, tidal flats, or deltaic environments. Fossil groups found within Silurian rocks include sponges, corals, clams, snails, and other typical sea fossils (Tesmer 1981). Fossils are generally uncommon in some of the units of the Medina, Clinton, and Lockport Formations (see Table 3.4-1 for a general description of the fossils found within each formation member).

Table 3.4-1 Common Fossils within the Lockport, Clinton, and Medina Groups

Medina Group	
Member Name	**Predominant Fossil Types**
Whirlpool sandstone	Floral microfossils and fragmented phosphatic marine fossils.
Power Glen shale	Crinoids, trace fossils, pelecypods, brachiopods, ostracods, and bryozoan.
Devils Hole sandstone	Bryozoans, gastropods, nautiloids, and trace fossils.
Grimsby Formation	Pelecypods, cephalopods, ostracods, bryozoans, and brachiopods.
Thorold sandstone	Ostracods, some brachiopods.

Table 3.4-1 Common Fossils within the Lockport, Clinton, and Medina Groups

Medina Group	
Cambria shale	Ostracods, bivalves, and abundant trace fossils
Kodak sandstone	Fossils are generally uncommon. May find some trace fossils.
Clinton Group	
Member Name	**Predominant Fossil Types**
DeCew dolomite	Crinoids, brachiopods, trilobites (casts and impressions), conodonts, and graptolites.
Rochester shale	Bryozoans, brachiopods, trilobites, crinoids, ostracods, and stromatoporoids.
Irondequoit limestone	Brachiopods, rugose coral, and bryozoan.
Rockway dolomite	Trace fossils and brachiopods.
Williamson shale	Graptolites, brachiopods, and gastropods.
Merritton limestone	Brachiopods, crinoids, and corals.
Reynales limestone	Bryozoans, brachiopods, and crinoids.
Neahga shale	Ostracods and brachiopods.
Lockport Group	
Member Name	**Predominant Fossil Types**
Guelph dolomite	Fossils are generally uncommon. May find stromatolites, brachiopods, ostracods, corals, and stromatoporoids.
Eramosa dolomite	Fossils generally uncommon. May find brachiopods, corals, gastropods, and bryozoan.
Goat Island dolomite	Fossils are generally uncommon. May find brachiopods, stromatoporoids, and corals.
Gasport dolomite	Crinoids, brachiopods, bryozoan, corals, and stromatoporoids.

Sources: Brett et al. 1995, 1999; Kilgour 1966; Hettinger 2001; Tesmer 1981.

3.4.4 Groundwater Resources

In terms of storage at any given time, groundwater represents the largest single supply of freshwater available for human use (USGS 1999). The following subsections describe groundwater resources within the Study Area.

Groundwater is contained in aquifers that vary from high to low permeability and occur at various depths below the surface. An aquifer is a body of permeable rock that contains or transmits groundwater. There are no primary, principal, or sole source aquifers (aquifers that supply at least 50% of the drinking water in the area that sits over the aquifer) located within the Niagara Escarpment. Most water-bearing zones are found within the bedrock that makes up the escarpment. Groundwater within the Niagara Escarpment is recharged primarily through precipitation and ultimately discharges into the Niagara River or Lake Ontario.

There is evidence of groundwater discharges from bedrock to the lower plains of the escarpment throughout the Study Area. Specifically, the swampy area on the eastern side of Scovell's Knoll in Artpark shows evidence of year-round groundwater flows from artesian (confined aquifer) conditions, where groundwater flows from above the escarpment through fissures in the bedrock to the lower plains and into the Niagara River (Eckel 2004). Additional seeps and groundwater discharges were identified at ten other sites along the escarpment: five in Lewiston, two in Cambria, two in Lockport, and one in Royalton.

Lockport Group

The Lockport Group, which is the uppermost bedrock formation along most of the Niagara Escarpment and is composed of dolomite, is the only significant aquifer within the Niagara Escarpment (Johnston 1964). Groundwater is able to move through this bedrock formation in three types of openings: 1) bedding joints, 2) vertical joints, and 3) small cavities from which gypsum has dissolved. Additionally, the water exists under artesian (a confined aquifer), semi-artesian (semi-confined aquifer), and unconfined conditions, with artesian conditions being most prevalent. The bedding joints within the Lockport Group can be further defined into seven distinct water-bearing zones (Johnston 1964). However, the relationship between all three types of openings results in two distinct sets of groundwater conditions within the Lockport Group: 1) a moderately permeable zone at the top, approximately 10- to 15-feet thick, that has both bedding and vertical joints that have been widened by gypsum cavities and solution, and 2) the seven permeable zones of bedding joints that are surrounded by impermeable rock below the top portion (Johnston 1964). These seven lower zones are all artesian.

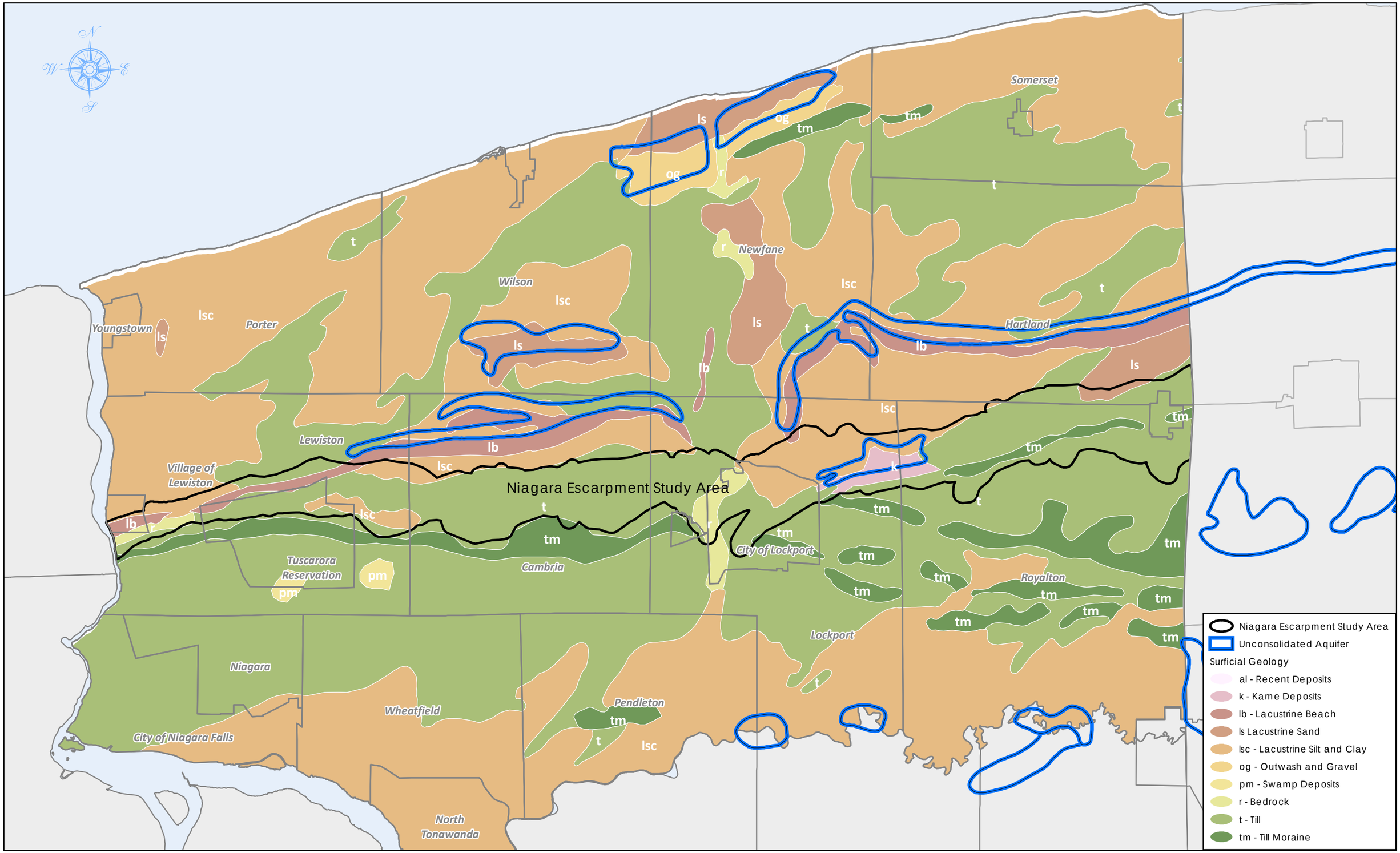
The minerals in these rocks generally result in a very hard and moderately to highly mineralized water, generally a calcium-sulfate or calcium-bicarbonate water that requires some type of treatment (softening, chlorination, or aeration) before use. In the lower water-bearing zones, higher salinity is often also noted (Johnston 1964).

Clinton and Medina Group

The Clinton and Medina Groups are composed primarily of limestones and sandstones, but they are not a primary source of groundwater because they are overlain by the Lockport Group (Johnston 1964). While the limestones and sandstones are generally more permeable and vertical and bedding joints are abundant, the Rochester shale found near the top of the Clinton Group does not allow groundwater recharge.

Groundwater associated with this bedrock group is generally very hard and highly mineralized and is generally used for individual residences and for farming operations (Johnston 1964).

Figure 3.4-3 Surficial Geology and Aquifers within the Niagara Escarpment Study Area - Niagara County, New York



Data Sources: NYSDEC 2008; NYS Museum, NYS Geological Survey 1999

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Queenston Shale

The Queenston shale, which forms the base of the bedrock along the Niagara Escarpment, is less permeable than the Lockport, Clinton, and Medina Groups. Groundwater is usually found within the fractured, weathered zone at the top of the formation but is generally less than 1-foot thick and so this zone is often found to be dry (Johnston 1964). Average yield within the wells is often insufficient for one family. The water is very hard and locally highly mineralized, requiring treatment before most uses.

Unconsolidated Deposits

The unconsolidated deposits are divided into two groups based on their water-bearing characteristics: 1) coarse-grained, highly permeable materials or 2) fine-grained materials with low permeability. The coarse-grained materials consist of sands and gravels, which tend to hold little water as they are generally found on topographic highs and drain rapidly. The fine-grained materials consist of glacial till and lake deposits. The glacial till is poorly sorted, which leads to low permeability. Lake deposits, composed of clay, silt, and fine sand, are usually very dense and compact, leading to low permeability and low yield. Water within the unconsolidated deposits tends to be very hard but not as highly mineralized as the water from bedrock (Johnston 1964).

3.5 Soils

There are seven soil associations in the Niagara Escarpment Study Area. These associations fall into five categories:

1. Areas dominated by soils formed in glacial till
2. Areas dominated by soils formed in gravelly glacial outwash or in beach and bar deposits
3. Areas dominated by soils formed in lake-laid sands
4. Areas dominated by soils formed in lake-laid silts and very fine sands
5. Areas dominated by soils formed in lake-laid clays and silts.

The associations found within the Study Area are shown in Table 3.5-1. Figure 3.5-1 illustrates the distribution of these associations in Niagara County and the Study Area.

The Appleton-Hilton-Sun Association is deep and consists of moderately well-drained to very poorly drained soils with medium-textured subsoil. This association covers approximately 14% of Niagara County; however, it occupies only 0.3% of the Study Area. This association has some value for farming. Drainage is the primary management issue on this soil association. When drained, the association is well-suited to dairy and livestock farming. The depth of the soil and compaction of the underlying till limit fruit farming in some areas (USDA 1972).

Table 3.5-1 Soil Associations Found in the Study Area

Name	Acres	Percent of Study Area
Hilton-Ovid-Ontario	22,628.87	69.0%
Rhinebeck-Ovid-Madalin	5,936.63	18.1%
Niagara-Collamer	3,210.82	9.8%
Lockport-Ovid	881.28	2.7%
Appleton-Hilton-Sun	105.65	0.3%
Claverack-Casad-Elnora	15.40	<0.1%
Odessa-Lakemont-Ovid	12.57	<0.1%
Total	**32,791.21**	**100.0%**

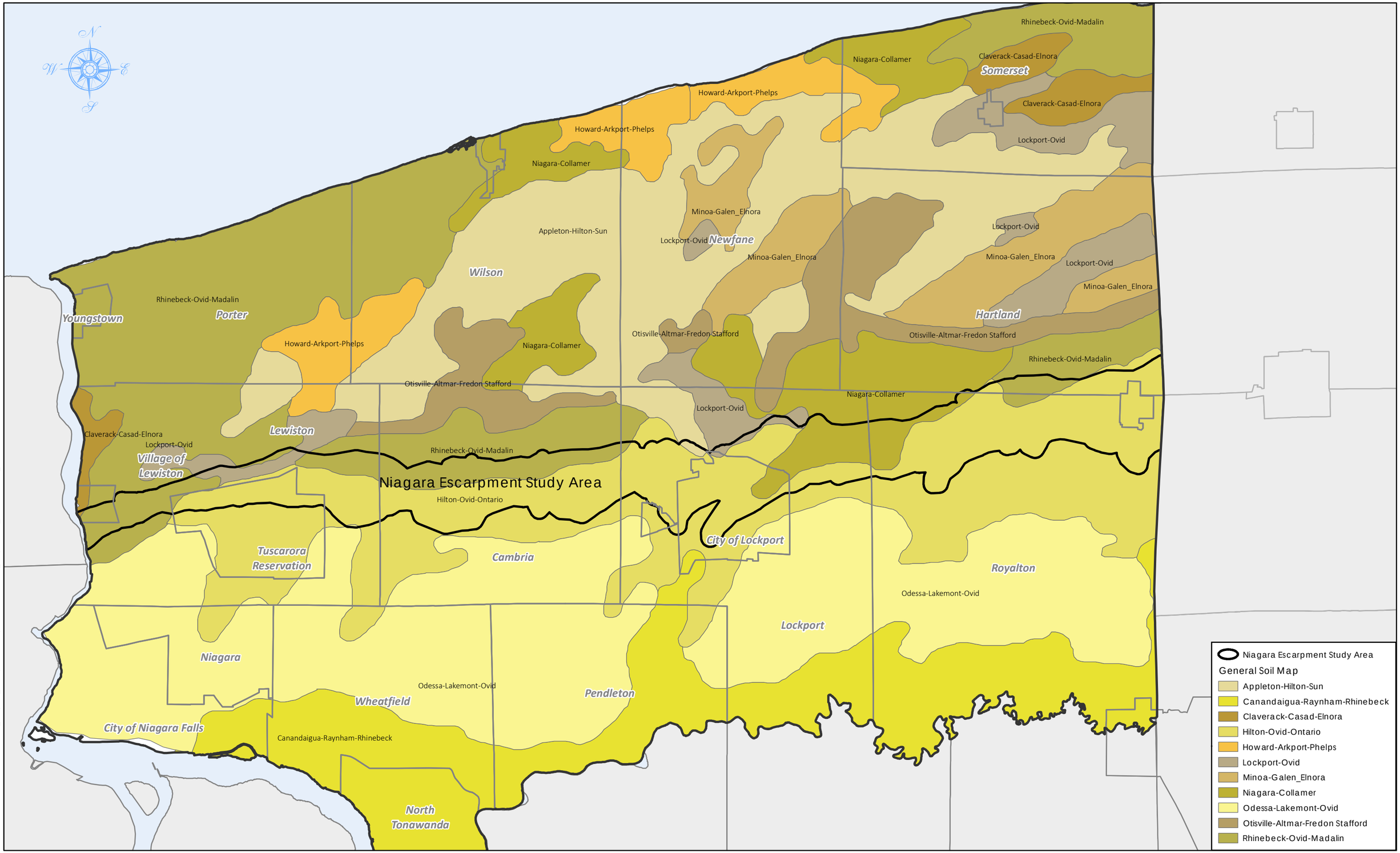
Source: USDA SSURGO 2010

The Hilton-Ovid-Ontario Association is dominated by soils formed in glacial till. It is characterized by deep, well-drained to somewhat poorly drained soils having a medium-textured or moderately fine-textured subsoil (USDA Natural Resources Conservation Service 1972). This association covers approximately 15% of Niagara County and is the most common soil series in the Study Area, occupying 69% of all soils. The soils in the City of Lockport, which is in the Study Area, consist of this association. The primary agricultural activity is dairy farming, although the area along the escarpment between Lockport and Gasport also supports fruit farms. Stone and bedrock limit development to some extent, and slope and erosion are also a concern near the escarpment (USDA Natural Resources Conservation Service 1972).

Like the Hilton-Ovid-Ontario Association, the Lockport-Ovid Association is dominated by soils formed in glacial till. It is characterized by poorly drained, moderately deep and deep soils with a fine or moderately fine-textured subsoil (USDA Natural Resources Conservation Service 1972). Most of this association has nearly level soils. Approximately 5% of the county is composed of this association and is 2.7% of the Study Area. This association contains the poorest farming soil in Niagara County, and the difficultly in establishing and maintaining lawns on this soil makes it less than ideal for residential use, as well. Many of the soils within this association have reverted to forest (USDA Natural Resources Conservation Service 1972).

The Claverack-Cosad-Elnora Association is dominated by soils formed in lake-laid sands and is characterized by deep, moderately well-drained to poorly drained soils with a coarse subsoil that overlays clay or fine sand. This association covers approximately 4% of Niagara County and represents less than 0.1% of the soils in the Study Area. These soils have some value for farming, particularly vegetable and fruit farms (USDA Natural Resources Conservation Service 1972).

Figure 3.5-1 General Soils within the Niagara Escarpment Study Area - Niagara County, New York



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The Niagara Collamer Association has a preponderance of soils formed in lake-laid silts and very fine sands. It consists of deep soils that are somewhat poorly drained or moderately well-drained. It covers approximately 6% of the county and 9.8% of the soils in the Study Area. Niagara and Collamer soils typically have a medium-textured to moderately fine-textured subsoil that is valuable for farming. Development on these soils is limited by drainage, erosion, permeability, and soil instability (USDA Natural Resources Conservation Service 1972).

Two soil associations dominated by soils formed in lake-laid clays and silts are the Rhinebeck-Ovid-Madalin Association and the Odessa-Lakemont-Ovid Association (USDA Natural Resources Conservation Service 1972). The Rhinebeck-Ovid-Madalin Association is characterized by poorly drained to very poorly drained soils with a fine or moderately fine-textured subsoil. The soils are deep and the subsoil is predominantly brown or olive. Some areas have unstable soils that formed in deep lake deposits. This association covers approximately 15% of Niagara County and 18.1% in the Study Area. It is of moderate value for farming and some fruit farms (apples, grapes, and pears) are located on these soils (USDA Natural Resources Conservation Service 1972).

The Odessa-Lakemont-Ovid Association is the largest soil association in Niagara County but it represents less than 0.1% of the soils in the Study Area. It has level or nearly level soils that are poorly drained to very poorly drained, with fine or moderately fine-textured subsoil. These soils are deep and predominantly red-hued. This association is less valuable as farmland than other associations in the county, and land composed of these soils near Niagara Falls and Lockport have been developed (USDA Natural Resources Conservation Service 1972).

3.5.1 Soils Associated with Niagara Escarpment Ecological Communities

Several types of soils are associated with the Niagara Escarpment and limestone barrens communities. These soils are of particular importance when determining the extent of the ecological communities associated with the escarpment. Soils associated with the escarpment were determined based on consultation with NYSDEC and were preliminarily divided into three categories:

- Very close correlation with Niagara Escarpment and associated limestone barrens communities
- Close correlation with Niagara Escarpment and associated limestone barrens communities
- Correlation with the Niagara Escarpment and associated limestone barrens communities.

These soil categories were developed by NYSDEC based on a review of the *Soil Survey of Niagara County* (USDA Soil Conservation Service 1972) in order to identify soil units that were either mapped along known segments of the

escarpment or those with descriptions that specifically referred to the escarpment and/or limestone barrens areas. These mapped soils units were then compared with topographic contours of the escarpment as provided by USGS maps. Depending on the degree of correlation, the soils were rated as having a "correlation," "a close correlation," or "a very close correlation" with the escarpment and the associated limestone barrens communities.

Nine soils units are considered very closely correlated, six soils units closely correlated, and seven soils units correlated with the escarpment (Table 3.5-2). The distribution of these soils is illustrated in Figure 3.5-2. The soils that are very closely correlated with the escarpment geology were used to define the Study Area. As discussed in Section 1.3, the Study Area was expanded to include a buffer area to ensure that these soils and associated ecological communities were included in the study. The other two categories were more widely distributed throughout Niagara County so the Study Area was not modified to include these soils.

Table 3.5-2 Soils Correlated with the Niagara Escarpment and Associated Limestone Barrens

Symbol	Name	Description
Soils Very Closely Correlated with the Niagara Escarpment		
CcC	Cayuga and Cazenovia silt loams, 6% to12% slopes	This soil occurs mainly along the north slope of the escarpment, typically in areas less than 20 acres.
HmB	Hilton & Cayuga silt loams, limestone substratum, 3% to 8% slopes	This soil is found near the escarpment, mostly parallel to and within 1 mile of the escarpment. Bedrock is found at a depth of 3.5 feet to 6 feet below the surface, and stone and large boulders are common.
HuF3	Hudson soils, 20% to 45% slopes, eroded	The largest acreage of this soil is located on the north face of the Lockport escarpment, south of Gasport. Most of these areas are less than 20 acres in size and are found in long, narrow strips on stream banks.
OnC	Ontario loam, 8% to 15% slopes	This soil is found near the escarpment and slopes to the north. This soil is found in areas less than 20 acres in size. Runoff on these soils is moderate to rapid and there is potential for erosion.
OnC3	Ontario loam, 8% to 15% slopes, eroded	This soil is the same as the soil above, except that it is experiencing erosion.
OnD3	Ontario loam, 15% to 30% slopes, eroded	This soil is located near the escarpment or near areas of glacial till dissected by streams. Most areas are less than 10 acres. This soil has rapid to very rapid runoff and is eroding.

Table 3.5-2 Soils Correlated with the Niagara Escarpment and Associated Limestone Barrens

Symbol	Name	Description
OoB	Ontario loam, limestone substratum, 3% to 8% slopes	This soil is found near limestone areas and is generally underlain by bedrock at a depth of 3.5 feet to 6 feet. This soil is prone to drying out during extended periods of drought or low precipitation.
RoA	Rock land, nearly level	This unit is found on areas of the escarpment and consists of rock outcrops and very shallow soils over rock. Runoff over this land is slow.
RoF	Rock land, steep	This unit is the same as the unit above, except that slopes are greater than 15%. This rock land is found on the north face of the escarpment.
Soils Closely Correlated with the Niagara Escarpment		
FaA	Farmington silt loam, 0% to 8% slopes	This soil is found over limestone bedrock, within 20 inches of the surface. Runoff is slow to moderately rapid. Erosion potential is moderate.
HgB	Hilton gravelly loam, 3% to 8% slopes	This soil is found in small knolls in a generally flat landscape in narrow strips along drainage ways. Runoff is moderate and there is a potential for erosion. This soil is suitable for cropland.
HmA	Hilton & Cayuga silt loams, limestone substratum, 0% to 3% slopes	This soil is found near the escarpment, mostly parallel to the escarpment. It is generally within 1 mile of the escarpment. The soils in this unit are suitable for crops, pasture, or trees.
OoA	Ontario loam, limestone substratum, 0% to 3% slopes	This soil is found near limestone rock outcrops and is underlain by limestone bedrock at a depth ranging from 3.5 feet to 6 feet. This soil is suited to most crops grown in Ontario soils.
OwA	Ovid silt loam, limestone substratum, 0% to 3% slopes	This soil is found near the escarpment and at areas underlain by limestone bedrock at depths from 3.5 feet to 6 feet. This area is not suitable for crops because of the depth to bedrock and need for drainage.
OwB	Ovid silt loam, limestone substratum, 3% to 8% slopes	This soil is the same as the soil above, but slopes are greater. It has a moderate potential erosion if cultivated.
Soils Correlated with the Niagara Escarpment		
CcA	Cayuga and Cazenovia silt loams, 0% to 2% slopes	This soil is found both north and south of the escarpment. These soils are well- to moderately well-drained. In many areas this soil is used for farming.
CcB	Cayuga and Cazenovia silt loams, 2% to 6% slopes	This soil is the same as the soil described above but has steeper slopes and has potential for erosion.

Table 3.5-2 Soils Correlated with the Niagara Escarpment and Associated Limestone Barrens

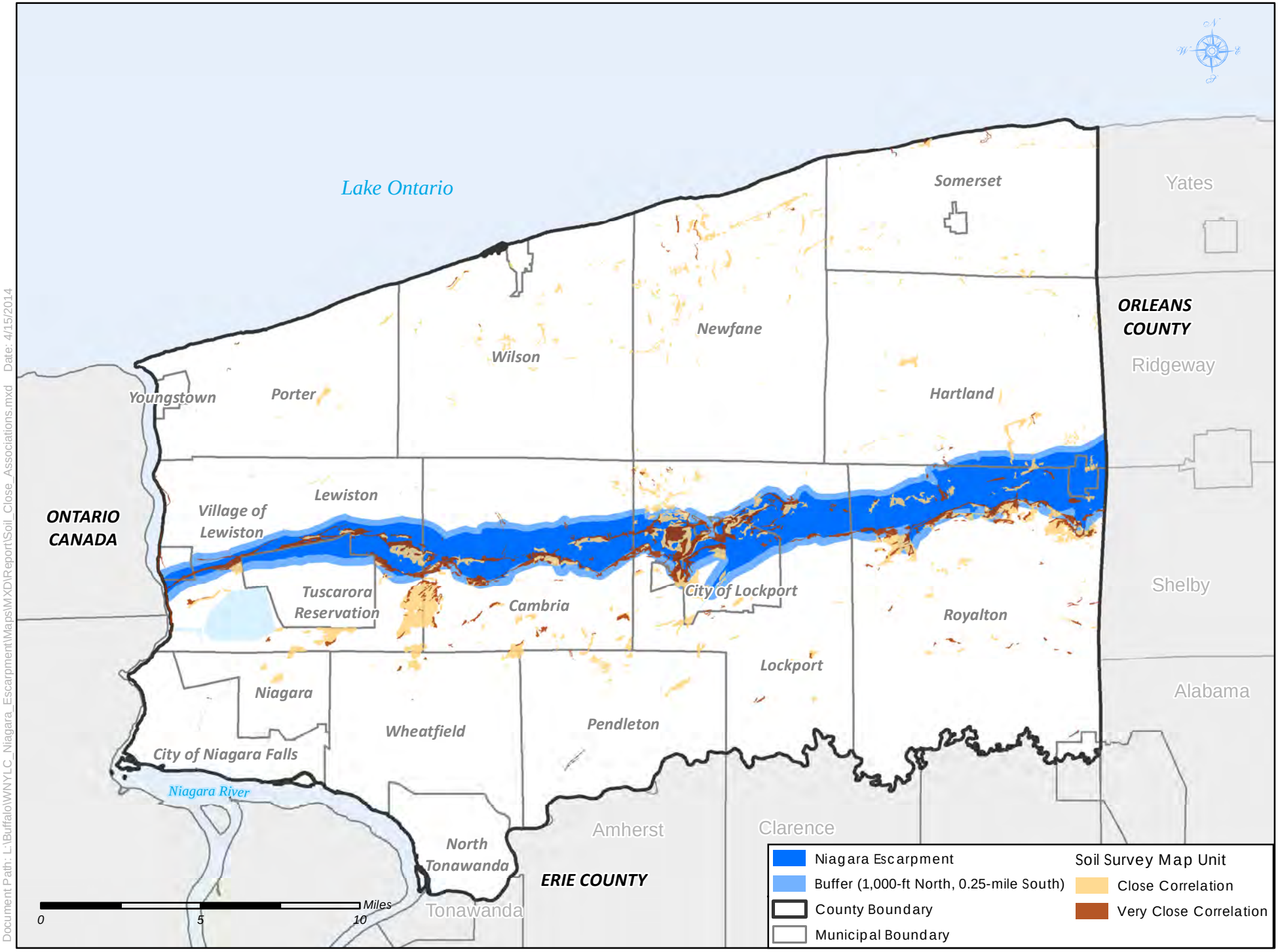
Symbol	Name	Description
DuC3	Dunkirk silt loam, 6% to 12% slopes, eroded	This soil is found near streams and drainage ways in dissected areas. In many places the original surface layer has been removed. This soil has been eroded and continues to have potential for erosion. It is suited to agricultural use for long-term crops or fruit trees.
DvD3	Dunkirk and Arkport soils, 12% to 20% slopes, eroded	This soil is eroded and steeply sloped. There is an erosion hazard and the soil is best used as pasture land or for trees.
HlA	Hilton silt loam, 0% to 3% slopes	This soil is found primarily on the top of glacial ridges. This soil is suitable for cropland.
HlB	Hilton silt loam, 3% to 8% slopes	This soil is found most commonly along the sides of ridges. This soil commonly occupies narrow strips along the side of ridges. This soil is well suited to cropland.
OnB	Ontario loam, 2% to 8% slopes	This soil is normally found on the top of the glacial till ridges south of the escarpment. This soil is well-suited to farming.

Source: USDA NRCS 1972

3.5.2 Farmland Soils

Approximately 12,954 acres (41.7%) in the Study Area are considered prime farmland. An additional 10,016 acres (32%) would be prime farmland if drained, and 3,104 acres (10%) are considered farmland of statewide importance. The distribution of farmland soils in the Study Area is presented in Appendix A. These soils support the agriculture within the Study Area. The prime farmland soils, together with the microclimates in the area, allow agriculture to thrive along the escarpment. Agricultural land use is discussed further in Section 3.7.2.

Figure 3.5-2 Soils Correlated with the Niagara Escarpment - Niagara County, New York



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Data Sources: USDA, NRCS 2011

3.6 Water Resources

The Study Area is located in both the Oak Orchard-Twelve Mile and Niagara sub-basins (Hydrologic Unit Codes [HUC] 04130001 and 04120104, respectively), both of which drain into the Great Lakes (EPA 2013c). Water resources include surface water, groundwater, floodplains, and wetlands. The Study Area consists of a total of 1,881.1 acres of NWI wetlands and 248 acres of NYSDEC wetlands (see Table 3.1-8), in addition to 22 NYSDEC streams (see Table 3.6-1). Aquatic habitat and characteristic species for palustrine and riverine systems are discussed in Sections 3.1.2 and 3.1.3, respectively. Geologic formations and associated groundwater resources are discussed in Section 3.4.4. This section discusses water quality of the Niagara Escarpment.

3.6.1 Water Quality

In New York State, all waterbodies receive a designation of water quality classification based on existing or expected best use of each water segment. A classification of AA or A is assigned to water whose best use is as a source of drinking water; B indicates best use is for swimming and other contact recreation but not for drinking water; C is for waters that support fisheries and are suitable for non-contact activities. The lowest water quality classification is D, which includes waterbodies that do not meet the more stringent criteria. Waters with classifications of A, B, and C may also have a standard of (T), indicating that they may support a trout population, or (TS), indicating that they may support trout spawning. The special regulations associated with these designations are in place to help sustain these valuable and sensitive fisheries (NYSDEC 2013d). A list of the water quality classification of the each stream located within the Study Area is provided in Table 3.6-1.

NYSDEC data indicate that no designated wild, scenic, or recreational rivers exist along the Niagara Escarpment in Niagara County (NYSDEC 2013c). The Niagara River, at the western extremity of the Study Area, however, provides ample opportunities for hiking, fishing, boating, and passive wildlife observation and represents a dramatic example of how glacial ecology formed the region.

3.6.2 Impaired Waterbodies

Eighteen Mile Creek has been identified both as a Great Lakes Area of Concern (AOC) (in Newfane, New York) and as a federal Superfund site because of the historical overload of contamination from industrial waste, hazardous waste sites, municipal wastewater, storm water discharges, and combined sewer outfall discharges (EPA 2013a). Sediments, soil, and groundwater are contaminated in and around this waterbody, likely because of its proximity to known past industrial discharges, including dumping pesticides (EPA 2013a).

Before discharging into Lake Ontario, the creek flows northward for 15 miles from its headwaters just north of the New York State Barge Canal. According to recent NYSDEC site investigation work, as reported by the U.S. Environmental Protection Agency (EPA), contaminants found in the soil at sites along Eighteen

Mile Creek and its tributaries include pesticides/insecticides, mercury, polychlorinated biphenyls (PCBs), dioxins, furans, lead, zinc, copper, and other contaminants (EPA 2013a). Because of the levels of contamination, restrictions have been placed on dredging and on fish and wildlife consumption. Sediment contamination contributes to the degradation of benthos, the growth of fish tumors, and deformities in birds and animals and has an impact on the reproductive health of fish and humans (EPA 2013b).

Table 3.6-1 NYSDEC-Designated Streams Located in the Niagara Escarpment Study Area

Water Quality Classification[1]	Name of the DEC Stream in the Project Area	Length (miles)
C	Barge Canal	13.92
A	East Branch Eighteen Mile Creek	1.30
B	East Branch Eighteen Mile Creek	1.16
C	East Branch Eighteen Mile Creek	1.49
D	East Branch Eighteen Mile Creek	0.99
C	East Branch Twelve Mile Creek	1.23
D	Eighteen Mile Creek	2.98
C	Fish Creek	0.48
C	Johnson Creek	3.56
C	Twelve Mile Creek	1.21
A	Unnamed tributary to East Branch Eighteen Mile Creek	0.51
A	Unnamed tributary to Johnson Creek	0.46
B	Unnamed tributary to East Branch Eighteen Mile Creek	0.04
B	Unnamed tributary to Twelve Mile Creek	0.06
C	Unnamed tributary to East Branch Eighteen Mile Creek	0.32
C(T)	Unnamed tributary to East Branch Eighteen Mile Creek	1.56
C	Unnamed tributary to East Branch Twelve Mile Creek	16.73
C	Unnamed tributary to Johnson Creek	10.54
C	Unnamed tributary to Niagara River	0.54
C	Unnamed tributary to Twelve Mile Creek	7.72
D	Unnamed tributary to East Branch Eighteen Mile Creek	15.61
D	Unnamed tributary to Eighteen Mile Creek	14.03

Source: NYSDEC 2010

[1] Water Quality Classifications:
AA or A: waters used as a source of drinking water
B: best usage for swimming and other contact recreation but not for drinking water
C: waters supporting fisheries and suitable for non-contact activities
D: lowest classification and standard
(T): may support a trout population
(TS): may support trout spawning.

3.7 Land Use

Land use data and land cover data (more specifically, land development and vegetation type, respectively) are two separate and distinct databases that provide a different view of the land types and uses along the escarpment.

Land use data is based on the Niagara County zoning parcel data, which indicates the land use that is currently allowed (see Table 3.7-1). Although zoning data is not a perfect representation of the actual land use, it provides a general understanding of the way land can be used within the Study Area. Land use (zoning) by parcel mapping along the Study Area is presented in Appendix A.

Table 3.7-1 Land Use Class (Zoning) within the Niagara Escarpment Study Area

Land Use Class	Acres	% of Study Area
Residential	10,376	33.3%
Agriculture	9,880	31.7%
Vacant	4,266	13.7%
Park or Recreation Area	2,183	7.0%
Tuscarora Nation*	1,499	4.8%
Public or Community Service	1,222	3.9%
Commercial	754	2.4%
Industrial	656	2.1%
Unclassified	292	0.9%
Other Natural Area (Public)	26	0.1%
Forested (Private)	5	0.02%

Source: New York State Office of Tax and Finance 2012
*Land use data for the Tuscarora Nation are not available.

Land cover data from the USGS GAP Analysis was used to provide a general overview of the types of land cover along the escarpment (see Table 3.7-2). Land cover data, although not available on a parcel by parcel breakdown, provide a general overview of the types of land vegetative cover, regardless of how the land is classified/zoned for use.

Table 3.7-2 Land Cover within the Niagara Escarpment Study Area

Land Use Class	Acres	% of Study Area
Herbaceous Agricultural Vegetation	16,953.43	51.9%
Temperate and Boreal Forest	9,244.79	28.6%
Developed & Urban	5,258.23	16.0%
Recently Disturbed or Modified	904.70	2.8%
Open Water	209.14	0.6%
Introduced & Semi-Natural Vegetation	68.12	0.2%
Temperate & Boreal Shrubland & Grassland	44.79	0.1%

Source: USGS 2001

The Study Area covers approximately 31,200 acres in Niagara County with 11 different land use classes. The two most prevalent land uses are residential (33.3%) and agricultural (31.7%). There are seven different land cover types, with the majority being herbaceous agricultural vegetation (51.9%). The second most prevalent land cover in the Study Area is temperate and boreal forest (28.6%). The land cover mapping (Figure 3.7-1) indicates that most of this forest is not contiguous. The largest stretches of contiguous forest are associated with the Tuscarora Nation Territory and with the Town of Lockport.

An exact comparison of change in land cover over time within the Study Area cannot be made because of changes in methods of land cover reporting over time. However historical mapping from 1970 to 1980 is provided in Figure 3.7-2. A comparison of this historical mapping with 2006 land cover data (Figure 3.7-1) indicates that there has not been a major shift in land cover within that 40-year time period.

3.7.1 Public Lands and Conserved Areas

Park land and recreational areas account for seven percent of the Study Area (see Figure 3.7-3). National Heritage sites and Artpark are described in Section 2.5.1, while sites on the National Register of Historic Places are listed in Section 2, Table 2.1-1.

3.7.1.1 New York State Parks

There is one state park in the Study Area, Earl Brydges Artpark State Park, which is commonly referred to as Artpark, previously described in Section 2.5.1.

3.7.1.2 Niagara County Parks

Three Niagara County-owned properties in the Study Area are open to the public for recreational use: Bond Lake County Park, Royalton Ravine County Park, and the Niagara County Fairgrounds.

Bond Lake Park

Bond Lake Park is situated on the lower slope of the Niagara Escarpment, next to the Tuscarora Nation Territory on Lower Mountain Road in the Town of Lewiston. The defining features of this park are its lakes, which were formed from abandoned limestone quarries.

In 1912, the limestone quarry at Bond Lake was leased by Empire Limestone, a division of the Lackawanna Steel Company, which used the limestone in the furnaces of their Lackawanna, New York, steel mill. By 1925, the costs of shipping the limestone caused quarry manager Fredrick Bond, Sr. to close the quarry and essentially abandon the land. The quarries were allowed to fill naturally with rainwater, and by the late 1920s the lakes that are there today had formed.

In 1964, Niagara County acquired Bond Lake's original 13 tracts by condemnation, for use as a recreational area for a total of $800,000. The land was not developed into a public park until 1976. The park currently encompasses more than 500 acres and is open to the public year-round.

The Niagara County Fairgrounds

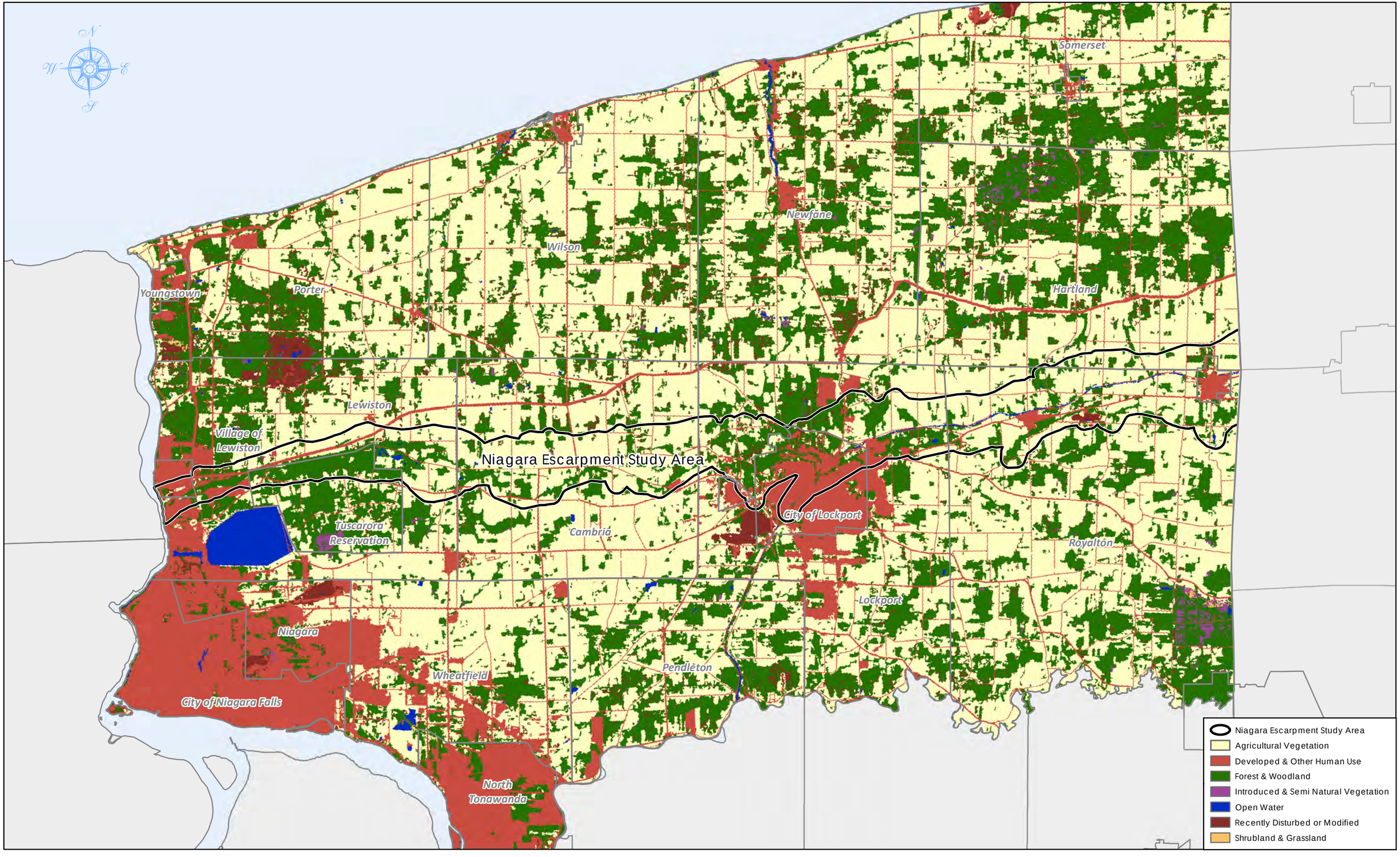
The Niagara County Fairgrounds are located on Route 78 not far from the City of Lockport. Besides hosting the annual Niagara County Fair in late July, the Fairgrounds have several other events such as car shows and concerts.

Royalton Ravine County Park

Royalton Ravine Park has a ravine that cuts through the Niagara Escarpment. The ravine is associated with the eastern branch of Eighteen Mile Creek, which was formed by drainage from the ancient, glacial Lake Tonawanda.

The park includes 143 acres of natural areas, a fishing pond, and several miles of trails. Additionally, the park contains the ruins of an historic home where Belva Lockwood was born in 1830. Ms. Lockwood was the first woman ever admitted to practice law before the Supreme Court and was the first woman to run for president of the United States, which she did twice, once in 1884 and again in 1888. Ms. Lockwood was an advocate for equal rights and worked with women's rights activists like Susan B. Anthony and Elizabeth Cady Stanton.

Figure 3.7-1 National Gap Analysis Program Land Cover Data in the Niagara Escarpment Study Area - Niagara County, New York

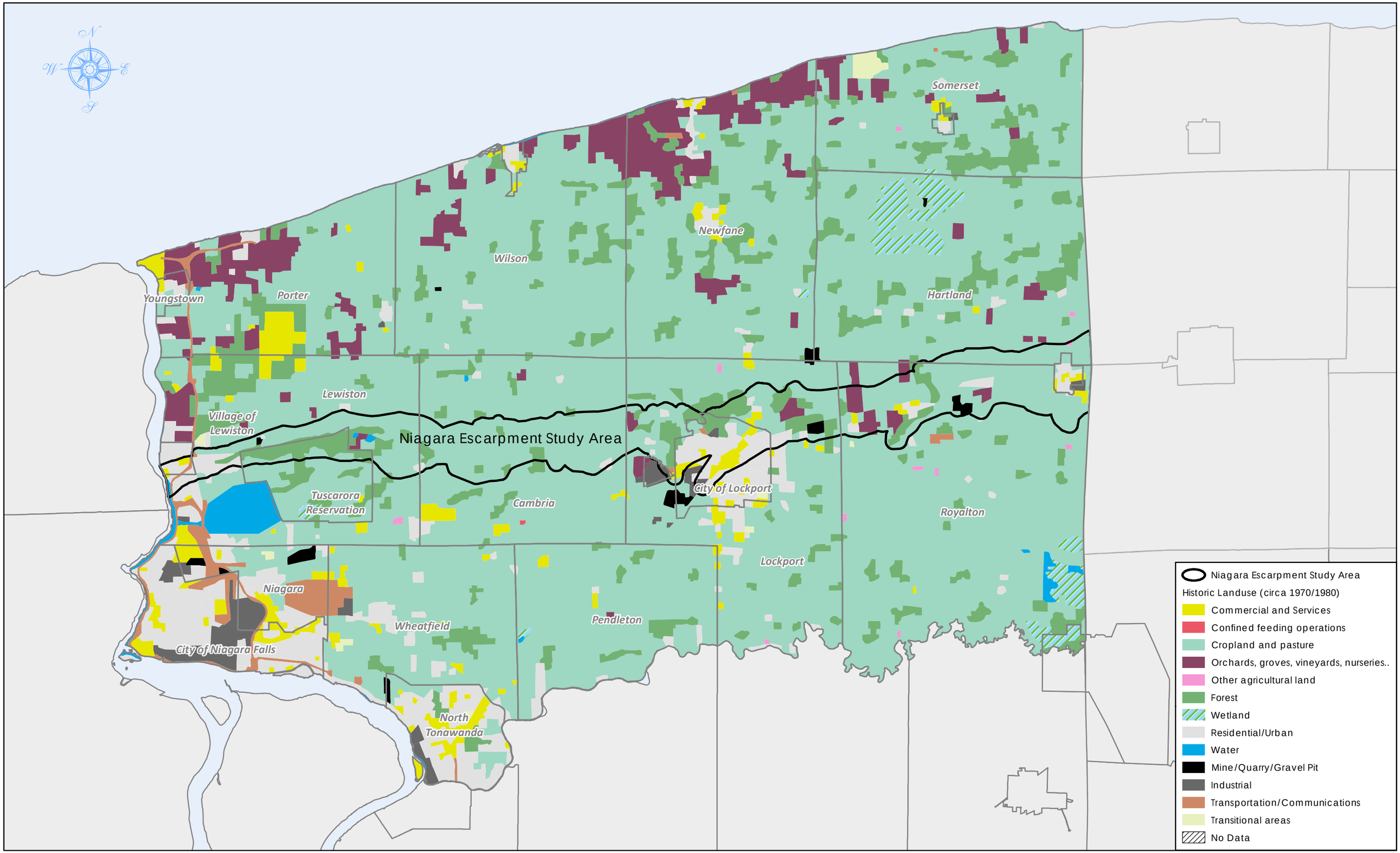


Document Path: L:\Buffalo\WNYLC_Niagara_Escarpment\Maps\MXD\thematic_maps\Mar6_2014\LandCover.mxd Date: 4/15/2014

Data Source: USGS, GAP Analysis Program 2011

0 5 10 Miles

Figure 3.7-2 Historic Land Use within the Niagara Escarpment Study Area - Niagara County, New York



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Data Source: USGS circa 1970/1980

0 5 10 Miles

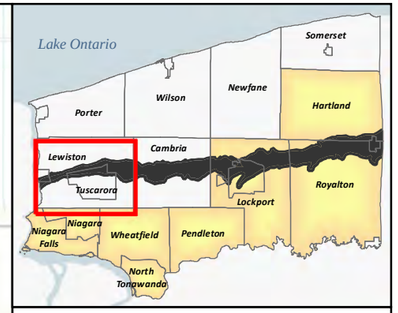

Figure 3.7-3
Public Recreation Areas within the Niagara Escarpment Study Area
Town of Lewiston

Public Recreation Area

- State Park
- Conservation Areas
- County Park
- Municipal Park

Base map

- Niagara Escarpment Study Area
- Municipality
- Native American Sovereign Nation
- Erie Canal National Heritage Corridor (See Inset)

Date: 5/8/2014

Data Sources:
ESRI (2012): Niagara County Office of Real Property (2012)

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Figure 3.7-3
Public Recreation Areas within the Niagara Escarpment Study Area
Town and City of Lockport

Public Recreation Area

- State Park
- Conservation Areas
- County Park
- Municipal Park

Base map

- Niagara Escarpment Study Area
- Municipality
- Native American Sovereign Nation
- Erie Canal National Heritage Corridor (See Inset)

Date: 5/8/2014

Data Sources:
ESRI (2012): Niagara County
Office of Real Property (2012)

0 0.25 0.5 1 Mile

Document Path: L:\Buffalo\WNYLC_Niagara_Escarpment\Maps\MXD\thematic_maps\Mar6_2014\Parks.mxd

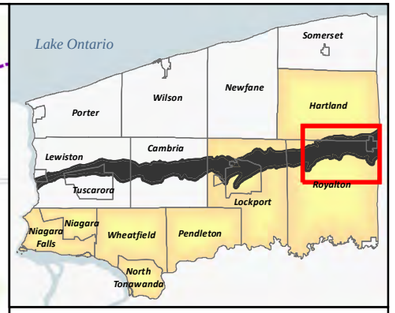

Figure 3.7-3
Public Recreation Areas within the Niagara Escarpment Study Area
Town of Royalton

Public Recreation Area
- State Park
- Conservation Areas
- County Park
- Municpal Park

Base map
- Niagara Escarpment Study Area
- Municipality
- Native American Sovereign Nation
- Erie Canal National Heritage Corridor (See Inset)

Date: 5/8/2014

Data Sources:
ESRI (2012): Niagara County
Office of Real Property (2012)

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3.7.1.3 Local Parks, Recreation and Conservation Areas

A variety of local parks are open throughout the Study Area. The highest density of local and municipal parks is in the town of Lockport, which is the most densely populated portion of the Study Area. Local parks in the Study Area are as follows:

- Village of Lewiston
  - Lewiston Plateau
  - Academy Park
  - Center Street Park (Freedom Crossing Monument)
- Town of Lockport
  - Sutliffe Rotary Park
  - Lytle Nature Preserve
  - Frank L. and Julia Dersham Young Niagara Escarpment Preserve
- City of Lockport
  - Rollin T. Grant Gulf Wilderness Park
  - Outwater Memorial Park
  - Upson Park
  - Scalzo Park
  - Carveth Packet Park
  - R. C. Betch Packet Park
  - Grossi Memorial Park
  - William Street Park
  - Canalside Park
  - Dudley Square Park
  - Veterans Memorial Park
  - Samuel Pecoraro Park
  - Dolan Park
  - Market Street Park
- Town of Royalton
  - Veterans Park
- Village of Middleport
  - Middleport Rotary Park
  - Margaret Dorman Park

3.7.1.4 Conservation Areas

Examples of conservation areas or nature preserves that are located in the Study Area include the Lewiston Plateau (Village of Lewiston), the Frank L. and Julia Dersham Young Niagara Escarpment Preserve (Land Conservancy), Rollin T. Grant Gulf Wilderness Park (City of Lockport), Lytle Nature Preserve (owned by the Town of Lockport and protected by a conservation easement held by the Land Conservancy), and Lockport Nature Trail (Town of Lockport). A brief description of these conservation areas is provided in Table 3.7-3.

Source: Western New York Land Conservancy

Lytle Nature Preserve prairie restoration

Table 3.7-3 Examples of Conservation Areas/Nature Preserves within the Niagara Escarpment Study Area

Name	Description
Frank L. and Julia Dersham Young Niagara Escarpment Preserve	The 36-acre property in Lockport has 1,000 linear feet of the Niagara Escarpment, 21 acres of contiguous mature hardwood forest, and 10 acres of restored grassland habitat (Maloni 2011). The forest is especially rich in spring ephemeral wildflowers. The property had been owned by the Young family since 1888 until the Western New York Land Conservancy acquired it in 2011, protecting it as a publicly accessible nature preserve. This is the Land Conservancy's first protected property along the escarpment. The property includes a few winding trails, accessible from Leete Road near Sunset Drive. The Land Conservancy hosts nature hikes there each spring.

Table 3.7-3 Examples of Conservation Areas/Nature Preserves within the Niagara Escarpment Study Area

Name	Description
Bond Lake Park	The Bond Lake Park, owned by Niagara County, is a 500-acre county park associated with an abandoned limestone quarry. Grassland restoration on approximately 100 acres of the park is currently under way.
Rollin T. Grant Gulf Wilderness Park	The Rollin T. Grant Gulf Wilderness Park, owned by the City of Lockport, is located where Eighteen Mile Creek crosses the Niagara Escarpment. This park supports a limestone forest community and species uncommon elsewhere in western New York, including hackberry and prickly ash (Niagara Frontier Wildlife Habitat Council n.d.).
Lytle Nature Preserve	The 75-acre Lytle Nature Preserve was donated to the Town of Lockport by William F. Lytle in 2008 and is protected by the Western New York Land Conservancy with a conservation easement. The property's diverse habitats include wetlands, mixed hardwood and pine plantations, farmland, and open meadows, including 47 acres of grassland being maintained as habitat for birds and other wildlife. The preserve can be accessed from Walnut Lane off of Old Niagara Road, just northeast of the City of Lockport. The preserve is located near the historic Erie Canal and is a great place to enjoy nature near the city (Smith 2010).
Lockport Nature Trail	The Lockport Nature Trail was originally purchased by the Town of Lockport as a quarry to mine stone for highway construction projects. Stone located at the site was not suitable for road construction in the area, and after decades without use, was developed into the town's first park in 2001. Located a few miles northeast of Lockport and north of the Erie Canal, the site features forested land, bedrock outcrops, a waterfall, and nature trails.
Lewiston Plateau	A managed turf area and the Lewiston Dog Park occupy 20 acres of land west of the Artpark grassland habitat area. Each area has public access and passive recreational trail routes and is managed in part by the Village of Lewiston. In 2011, the Village of Lewiston Board entered into a 10-year agreement with the Western New York Land Conservancy allowing the Land Conservancy "to enter the Village of Lewiston Grassland Restoration Site (on the plateau by Artpark's upper parking lot) for the sole purpose of enhancing native grasslands." The Western New York Land Conservancy's Grassland Restoration Project "will focus on the removal of the invasive species." The Niagara County Soil and Water Conservation District is assisting with this effort (Village of Lewiston 2011).

Source: Western New York Land Conservancy

Niagara Escarpment Preserve ribbon-cutting ceremony

Source: Western New York Land Conservancy

A public birdwatching hike at the Niagara Escarpment Preserve

Source: Town of Lockport Parks (website)

Various images of the diverse land uses available for public enjoyment at the Lockport Nature Trail.

3.7.2 Agriculture

Approximately 31.7% of the land within the Study Area is currently used for agricultural purposes, while 49% is classified as either prime farmland or farmland of statewide importance, based on favorable soil conditions, according to current soil data (USDA NRCS Soil Survey Geographic Database [SSURGO] 2010). An additional 32% of the Study Area would be considered prime farmland if drained. Agriculture in Niagara County includes dairy farms, horse farms, farm-raised meats, poultry farms, fiber farms, field crops, horticulture, orchards and small fruit, woodlots and Christmas trees, and vineyards. Average farm size for the county is approximately 165 acres. Most of New York's commercial fruit production comes from three regions: western New York (71%) on the south shore of Lake Ontario; the Hudson Valley (22%) in southeastern New York bordering the Hudson River within 100 miles of New York City; and the Champlain Valley (7%), bordering Lake Champlain and the state of Vermont in northeastern New York. Each region has its own strengths and caters to different but overlapping markets (Hoying, S. M. Fargione and T. Robinson. 2008). Niagara County ranks first in production of peaches, pears, and sweet cherries in New York State; seventh in grapes; and first in popcorn. It is ninth in the state for production value of grains, oilseeds, and dry beans and is also ranked high in grain and hay production (Cornell University Cooperative Extension n.d.).

3.7.3 Tourism

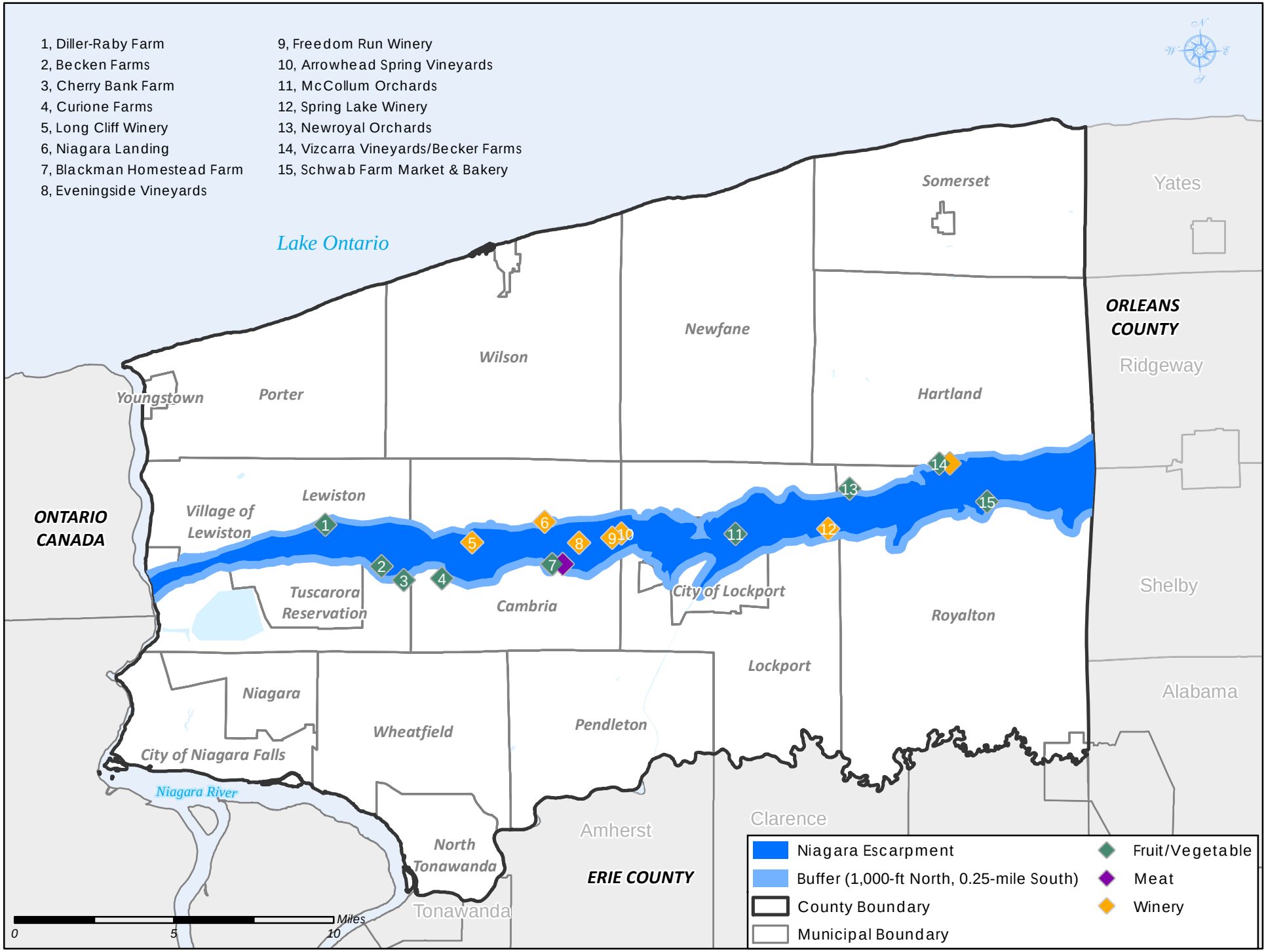
Niagara County's tourist destinations include Niagara Falls and other state parks along the Niagara Gorge. Annual visitors to Niagara Falls (New York and Ontario) number 22,500,000, according to the Niagara Tourism and Convention Corporation. Public parks and recreation areas, historical landmarks, and agri-tourism destinations draw people to the escarpment. Public parks such as Artpark have summer concerts and other public events. The Erie Canal National Historic Corridor draws tourists into Lockport. There are six wineries associated with the Niagara Wine Trail located in the Study Area. In addition to the Niagara Wine Trail there are six additional farms in the Study Area that are publicly accessible and grow and sell fruits and vegetables, raise animals, and offer a variety of farm-related goods such as wine, honey, fruit pies, and apple cider. These farms are

open to the public and some have U-Pick operations. These farms and vineyards benefit from the unique soil-climate relationship of the Niagara Escarpment (see Section 3.7.5). Table 3.7-4 and Figure 3.7-4 detail the locations and major commodities of each of these farms.

Table 3.7-4 Publicly Accessible Farms and Vineyards on the Niagara Escarpment

Map Number	Farm Name	Location	Commodity
1	Diller-Raby Farm	2055 Ridge Road, Lewiston	Fruit
2	Becken Farms	2585 Upper Mountain Road, Sanborn	Fruit, vegetables, other value-added products
3	Cherry Bank Farms	5140 Townline Road, Sanborn	Fruit, other value-added products
4	Curione Farms	3253 Upper Mountain Road, Sanborn	Fruit - Cherries
5	Long Cliff Winery	3617 Lower Mountain Road, Sanborn	Wine
6	Niagara Landing Wine Cellars	4434 Van Dusen Road, Lockport	Wine
7	Blackman Homestead Farm	4472 Thrall Road, Lockport	Fruit, meat (turkey, beef), other value-added products
8	Eveningside Vineyards	4794 Lower Mountain Road, Cambria	Wine
9	Freedom Run Winery	5138 Lower Mountain Road, Lockport	Wine
10	Arrowhead Springs Vineyards	4746 Townline Road, Lockport	Wine
11	McCollum Orchard	248 N. Adams Street, Lockport	Hops, fruit, vegetables
12	Spring Lake Winery	7373 Rochester Road (Rt 31), Lockport	Wine
13	Newroyal Orchards	7577 Slayton Settlement Road, Gasport	Fruit
14	Vizcarra Vineyards/Becker Farms	3724 Quaker Road, Gasport	Wine, fruit, other value-added products
15	Schwab Farm Market & Bakery	9035 Rochester Road, Gasport	Fruit, vegetables, other value-added products

Figure 3.7-4 Publicly Accessible Farms and Vineyards on the Niagara Escarpment



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3.7.4 Industry and Commerce

Less than 5% of the land in the Study Area is currently used for industrial or commercial purposes, and industrial and commercial development in Niagara County has been relatively stagnant for the last several decades. However, in recent years, advanced manufacturing, high-tech companies, data centers, and tourism development have expanded in the county. While commercial areas are found throughout the Study Area, most are densely concentrated in and around the City of Lockport (Niagara County Department of Economic Development 2013).

3.7.4.1 Industrial Impact on the Escarpment

Land along the escarpment has been affected by former and existing industrial activities, resulting in serious contamination. Three NYSDEC remedial sites and nine U.S. Environmental Protection Agency (EPA) National Priority List (NPL) sites are located in the Study Area. All but two of these remedial sites are located in the City and Town of Lockport. One of these sites is in the brownfield cleanup program, two are part of the environmental restoration program, and nine are part of the state Superfund program, which is administered by NYSDEC. Table 3.7-5 provides additional details regarding these sites.

Table 3.7-5 NYSDEC Remedial Sites and EPA National Priority List Sites on the Niagara Escarpment

Site Name (ID)	Program	Address	Town/City	Site Classification
NYSDEC Remedial Sites				
Commerce Square	NYSDEC Environmental Restoration Program	160 Washburn Street	City of Lockport	Non-Registry site where work is under way
Delphi Lockport Building 6 Tank Area	NYSDEC Brownfield Cleanup Program	200 Upper Mountain Road	Town of Lockport	Non-Registry site where work is under way
Richmond Avenue Project	NYSDEC Environmental Restoration Program	49,51,53,57,69,79,81 Richmond Avenue and 3&7 Niagara Street	City of Lockport	Non-Registry site where work is under way
EPA National Priority List Sites				
Eighteen Mile Creek Corridor	State Superfund Program	62, 70, 198 & 300 Mill Street	City of Lockport	Significant threat to the public health or environment - action required
FMC Corporation	State Superfund Program	100 Niagara Street	Village of Middleport	Significant threat to the public health or environment - action required

Table 3.7-5 NYSDEC Remedial Sites and EPA National Priority List Sites on the Niagara Escarpment

Site Name (ID)	Program	Address	Town/City	Site Classification
Guterl Specialty Steel Corp.	State Superfund Program	695 Ohio Street	City of Lockport	Significant threat to the public health or environment - action required
Lockport City Landfill	State Superfund Program	Oakhurst Road	City of Lockport	Site properly closed - requires continued management
NYSEG – Lockport Transit Street MGP	State Superfund Program	Between LaGrange & Saxton St./South Transit St.	City of Lockport	Non-Registry site where work is under way
NYSEG - State Road – Lockport MGP	State Superfund Program	State Road	City of Lockport	Non-Registry sites in any remedial program where work is under way
Old Upper Mountain Road Site	State Superfund Program	Old Upper Mountain Road	Town of Lockport	Significant threat to the public health or environment - action required
Stauffer Chemical - Art Park Site	State Superfund Program	4th Street	Village of Lewiston	Does not present a significant threat to the public health or the environment - action may be deferred
Van de Mark Chemical Company, Inc.	State Superfund Program	Mill Street	City of Lockport	Site properly closed - requires continued management

Source: NYSDEC 2008.

In addition, 377 EPA-regulated sites are located in the Study Area. These sites fall into several categories, including but not limited to brownfields properties, minor air permit sites, air monitoring sites, Superfund (non-National Priority List) sites, electric power-generating facilities, enforcement sites, sites with compliance activities, leaking underground storage tanks, sites with Spill Prevention Control and Countermeasure plans, sites with National Pollutant Discharge Elimination System permits, toxic release inventory sites, and pesticide producers. Although not all these sites are sources of existing contamination, they do indicate the types of activities in the Study Area that could be potential sources of contamination.

3.7.4.2 Active and Abandoned Mining Operations

A review of active and abandoned mining operations in the Study Area indicated that there are no underground mining operations along the escarpment; however, there are 25 surface mines, of which five are active, 15 are inactive (not permitted), and five have been reclaimed (NYSDEC 2013e). The active, inactive, and reclaimed mines in the Study Area cover 682 acres. The active mines currently account for 556 acres (82% of all mining operations) in the Study Area and include mining for clay (101 acres), sand and gravel (10 acres), and limestone (445 acres). These mines are located throughout the escarpment, with one in Lewiston, one in Lockport and one in Royalton. Ninety-nine acres of the 682 acres have been previously reclaimed. Table 3.7-6 provides an overview of the active and inactive mining operations within the Study Area.

Table 3.7-6 Active and Abandoned Mining Operations in the Study Area

Name of Mine	Commodity	Status	Total Acres Mined	Acres Reclaimed
Lewiston				
A-1 Topsoil Mine	Topsoil	Inactive	0	0
Adams/Pasell Ponds	Clay	Inactive	2	0
Bergey Pit	Clay	Active	26	0
Helmich Site	Clay	Active	52	35
Indian Hill Mine	Clay	Reclaimed (CERCLA* site)	10	7
Model City Road Site	Clay	Inactive	9	0
Modern - Model City Road	Clay	Inactive	20	0
Pond	Clay	Inactive	2	0
Wolf Farm Pond	Clay	Inactive	7	0
Cambria				
Fish Farm	Clay	Inactive	0	0
Martin Kroening Pond	Clay	Reclaimed	10	10
Pentad Agricultural Improvement	Clay	Inactive	0	0
Lockport				
Orangeport Orchard Gravel Pit	Sand and Gravel	Reclaimed (CERCLA Site)	15	15
Pond	Clay	Inactive	1	0
Slc Pit #1	Sand and Gravel	Inactive	5	0
Turner Gravel Pit	Sand and Gravel	Inactive	6	0
Wilson Road East	Clay	Active	23	0
Wilson Road West Sand Pit	Sand and Gravel	Active	10	0
Zona Property	Sand and Gravel	Reclaimed	7	7
Royalton				
Gasport Plant	Limestone	Active	445	0

Table 3.7-6 Active and Abandoned Mining Operations in the Study Area

Name of Mine	Commodity	Status	Total Acres Mined	Acres Reclaimed
Gasport Site	Topsoil	Inactive	1	0
Lake Motors Site	Topsoil	Inactive	6	0
LLBKTopsoil Mine	Topsoil	Inactive	0	0
Mark's Land Renovation	Sand and Gravel	Reclaimed (CERCLA Site)	25	25

Source: NYSDEC 2013e.
* CERCLA: Comprehensive Environmental Response, Compensation , and Liability Act

3.7.5 Microclimates along the Escarpment

The northern lake plain begins at Lake Ontario, where the elevation is 246 feet above sea level. It extends south to the foot of the Niagara Escarpment. There the elevation increases sharply to about 600 feet above sea level at the crest of the escarpment.

The climate of Niagara County is northern temperate and relatively mild, compared with other locations at similar northern latitudes in the United States. Niagara County's weather conditions are greatly influenced by the presence of Lake Ontario and Lake Erie. Lake Ontario is deep enough that lake ice forms only at shoreline edges during the coldest of winters. Landscape position and topography of the region contribute to the moderation of temperatures, cooling the area in the summer and moderating the cold air masses that flow southward from Canada during the winter. Lake Ontario has a warming effect into the fall and a cooling effect into the spring and early summer that provides a longer frost-free growing season in this portion of Niagara County than in surrounding areas. The modification of local temperature conditions is conducive to production of temperature-sensitive fruits and produce in the county. As a result of Niagara County's unique soil-climate relationships, the region produces more than 50 agricultural products in economic quantities. The cold lake waters that delay spring warming also benefit native, ephemeral plant communities and amphibians whose habitat remains conducive to reproduction longer.

Growing Season in the Study Area

Frost-free days: 143 to 162 days. Average last frost up to 5 miles from Lake Ontario, April 30; inland, May 10. Average first frost– October 13 along the Lake to September 30 inland.

Annual precipitation: Averages 32.6" (30" to 35" historic range) with growing season precipitation averaging 14.3."

Source: Ecology and Environment, Inc.

Scenic view from the Niagara Escarpment, Town of Cambria, with Toronto, Canada skyline visible in the distance

3.8 Scenic Resources

The Niagara Escarpment's 150-foot elevation over the flat lower Lake Ontario Plain is responsible for the spectacular views looking north. On clear days and nights, the northern view from the ridge of the escarpment includes the Toronto city skyline in the distance. Because of the views, the ridge of the escarpment is a desirable location for homes. Additionally, homes built on the lower northern plain at the base of the escarpment have beautiful southerly views of the geology and ecology of the escarpment. The scenic resources associated with the escarpment are important enough to be included in this study. A number of the significant views were noted and photographed as part of the field studies. These views are publicly accessible and are seen on the following pages along with their general location.

Source: Ecology and Environment, Inc.

Scenic view from the Niagara Escarpment, Town of Royalton

Spring ephemeral early meadowrue (*Thalictrum dioicum*), Lewiston

Cut-leaf toothwort in bloom in spring (*Cardamine concatenata*), Lewiston

Close-up of weathered and moss-covered escarpment outcrop, Cambria

Green frog (*Rana clamitans*), Lewiston

4 Analysis

The Niagara Escarpment Legacy Project is the most comprehensive study of the escarpment in Niagara County to date. In surveying ecological resources and then looking at the escarpment from social, historical, and land use perspectives, the Project has produced a full-spectrum portrait of the area. With such a wealth of quantitative and qualitative information at hand, the authors of the study can offer informed, long-range recommendations for the future conservation of this unique natural wonder that has played such a defining role in the region's history.

4.1 Summary of the Study's Findings

The escarpment is home to a wealth of flora and fauna, soil types, geology, and waterways in addition to its cultural history. Aerial photography shows that there are more forests along the escarpment than in surrounding areas, especially on land within the Tuscarora Nation Territory boundaries and in municipal parks. There remain substantial opportunities for conservation, education, and public access along the Niagara Escarpment in Niagara County.

Several species of plant, bird, and amphibians are on the state threatened lists and several more are listed by New York State as of special concern. While three state-listed threatened species and four species of special concern (see Table 4.1-1) were confirmed in the field surveys, which covered less than 10% of the land area of the escarpment, existing data would indicate that up to 43 species of threatened and endangered plants could occur in the area and 35 are likely to occur across the entire expanse of the escarpment (see Section 3.1.5). Eighteen bird species listed as of special concern (Section 3.2.1.3) have the potential to occur. However, further field surveys are necessary to confirm the presence of these species.

The escarpment's unique hydrology and geology create conditions that are suitable for rare ecological communities. Field surveys found oak openings community, alvar shrubland, alvar woodland communities, and talus caves. Oak openings are considered S1 ecological communities, meaning that they are critically imperiled in New York State. Although their presence along the escarpment must be confirmed, the discovery of the alvar shrubland and alvar woodland communities is significant because they had not previously been documented in this region. Talus caves represent another uncommon ecological community, and are formed by boulders at the bottom of cliffs. They have the

potential to provide habitat for species such as the timber rattlensnake and bobcat, as well as species of bats whose populations are in steep decline.

Table 4.1-1 Identified Threatened or Of Special Concern Species

Species		NYS Status	General Location Identified
Common Name	Scientific Name		
Plant			
Big shellbark hickory	*Carya laciniosa*	Threatened	Town of Lewiston
Smooth cliffbrake	*Pellaea glabella*	Threatened	Village of Lewiston
Yellow giant hyssop	*Agastache nepetoides*	Threatened	Town of Cambria
Bird			
Cooper's hawk	*Accipiter cooperii*	Special Concern	City of Lockport
Grasshopper sparrow	*Ammodramus savannarum*	Special Concern	Town of Cambria
Vesper sparrow	*Pooecetes gramineus*	Special Concern	Towns of Lewiston and Royalton
Amphibians			
Blue-spotted salmander	*Ambystoma laterale*	Special Concern	City of Lockport

Many of the escarpment's rock layers that were formed under a shallow sea during the Silurian Period are now evident as fossils. These include invertebrates such as sponges, corals, clams, snails and other typical sea fossils.

The Study also found opportunities for public access. There are numerous parks with trails as well as informal trails and abandoned rail right of ways throughout the escarpment that could be linked, expanded, or improved. There are scenic views, historic sites, vineyards and fruit orchards all of which enhance the livability of Niagara County and could provide economically valuable tourism opportunities.

Source: NYNHP

Example of oak-openings ecological community

Source: Ecology and Environment, Inc.

Landscape with alvar shrubland community characteristics, Lockport, New York

Source: Ecology and Environment, Inc.

Landscape with alvar woodland community characteristics, Cambria, New York

Source: Robert H. Mohlenbrock, USDA-NRCS PLANTS Database 1989.

Big shellbark hickory *(Carya laciniosa)*

Source: Patrick J. Alexander @ USDA-NRCS PLANTS Database

Smooth cliffbrake *(Pellaea glabella)*

Source: EPA 2012

Yellow giant hyssop *(Agastache nepetoides)*

Source: Ecology and Environment, Inc.

Cooper's hawk (*Accipiter cooperii*) in winter

Source: Ecology and Environment, Inc.

Juvenile grasshopper sparrow (*Ammodramus savannarum*)

Source: Ecology and Environment, Inc.

Vesper sparrow (*Pooecetes gramineus*)

Source: Greg Schechter, Wikimedia.org

Blue spotted salamander *(Ambystoma laterale)*

4.2 Threats to the Niagara Escarpment

The escarpment has shown impressive ecological resiliency over the centuries, even as it was subjected to use and overuse. The escarpment's forests have been used for lumber, while mining has taken sand, gravel, clay, and limestone for the construction industry. Portions of the escarpment were blasted and cut away to make way for transportation infrastructure like the Erie Canal and the Robert Moses Parkway, and industrial pollution has spoiled some of its waterways, including Eighteen Mile Creek, which is now considered an Area of Concern. While much of this damage is historic, there are ongoing processes that threaten the ecological integrity of the Niagara Escarpment in Niagara County.

4.2.1 Urban Growth

The majority of the Study Area is covered by herbaceous agricultural vegetation (51.9%), i.e., it is or recently was farmland. Forest is the second most prevalent land cover at 28.6%, with developed and urban land covering 16%. However, the last 40 years have seen a trend uncommon outside of upstate New York. According to the 2010 U.S. Census, although the population of Erie and Niagara County declined by more than 16% between 1970 and 2010, urbanized area increased by 78% during the same time period, a condition referred to as sprawl without growth. As population has decreased, conversion of farmland and forests to housing and other urban uses has dramatically increased.

This scenario also plays out along the Niagara Escarpment in Niagara County. Cities on the escarpment like Lockport, or in the vicinity of the escarpment like Niagara Falls, have been losing population while homes and commercial developments are being constructed in suburban or rural areas. This has an overall impact on the amount of forest or grassland cover, but also limits corridors between patches of open space, reducing biodiversity and wildlife habitat.

4.2.2 Invasive Species

Invasive species—both plants and animals—severely degrade plant community diversity and habitat value and have impacts on agriculture and forestry activities. Several invasive plant species were identified in the field surveys, each with the potential to do serious damage to local ecological communities and that have significant negative economic impact on agriculture.

Field surveys did not identify insect invasive species; however, infestations of both the emerald ash borer and the Asian longhorned beetle are well documented in New York State and are spreading rapidly.

4.2.3 Other Factors

A number of additional factors will impact efforts to preserve, restore, and create public access along the escarpment. One factor is the high level of contamination from former and existing industrial activities at multiple sites within the study area. These sites encompass approximately 10% of the study area and include three NYSDEC remedial sites, nine EPA National Priority List Sites, as well as 377 EPA-regulated sites.

In a predominantly rural county changing demographics are a factor with the potential to have a major impact on agricultural land. The United States Department of Agriculture preliminary 2012 Census of Agriculture report shows that the average age of New York State farmers has increased to 57 years old, nearly 17 years older than the average age of all working Americans (USDA 2012). Twenty-nine percent of New York State farmers are at retirement age (65 years or older), making it likely that much of New York State's farmland will be changing hands in the near future. According to the Cooperative State Research, Education, and Extension Service, 70% of United States farmland will change hands by 2028 (CSREES 2008). Careful succession planning is needed to stem the loss of Niagara County's farmland to costly residential development. Despite a declining population, Niagara county lost 9,491 acres of farmland, 6,469 acres (68%) of it to residential development from 2002 to 2007 (Niagara County 2009).

Niagara County has twenty municipalities including three cities, twelve towns and five villages, plus three Native American reservations/lands (Niagara County 2009), each with its own administration, land use policies and land protection priorities. The escarpment traverses a number of these municipal boundaries. Coordinating efforts across these physical boundaries and among multiple governing bodies whose composition changes with each election cycle presents a major challenge to coherent land use planning along the escarpment.

4.3 Next Steps

The Niagara Escarpment Legacy Project provides new information and an expanded framework for evaluating conservation opportunities along the escarpment. There is much work to be done. Section 5 provides goals and strategies for moving forward. In addition, here are other tasks that lie ahead for the conservators of the escarpment.

4.3.1 Conservation of Niagara Escarpment Sites

Based on the findings of the field surveys, the Land Conservancy has additional opportunities for conservation. As with the initial screening process discussed in Section 1.3, the following key attributes are being considered during this ongoing evaluation. They include the following:

- Unique geology (exposed rock faces, talus slopes)
- High biodiversity
- Rare species (plants, amphibians, birds)
- Unique or rare ecological communities
- Ecological connectivity
- Water features including wetlands, seeps, vernal pools and headwater streams
- Important cultural and historical features
- Potential public access.

4.3.2 Additional Studies

The findings from this study highlight the need for additional research and education. This study of only 19 sites along the escarpment, which included only 10% of the Niagara Escarpment, revealed many unusual ecological communities and under-appreciated historic features. The impact of these discoveries can be exponentially amplified if they are shared with the public and municipal leaders. Knowledge of the escarpment's many assets and a clear understanding of the strong links among open space preservation, quality of life and a community's economic vitality are critical to sound decision making about land use and preservation priorities along the escarpment.

This study provides an initial characterization of the escarpment, but several gaps in the knowledge remain. Additional studies could investigate and/or expand upon the following:

- Verification of NYNHP-listed ecological communities
- Threatened and endangered species and species of special concern occurrence
- Surface hydrology during different seasons at different sites
- Further ecological studies of priority sites identified by the Land Conservancy
- Additional ecological site characterizations
- Bat habitat and hibernacula study

Wooded stream below escarpment, Lockport

View up escarpment in summer, calcareous slope woodland, Lewiston

5 The Benefits of Conserving the Niagara Escarpment

In addition to the significant environmental benefits provided by open space and farmland preservation there are also profound impacts on quality of life and the character of the community. The aesthetic benefits from preserving scenic views are very important, and evidence suggests that preserving open space and farmland have significant economic and health benefits as well. This section discusses the benefits to communities and municipalities associated with land conservation practices.

5.1 Increasing Property Values and Tax Revenue

Studies have shown that private property values increase with proximity to protected open spaces. This is true with urban parks as well as protected natural areas. Land owners will see the value of their property rise, and municipalities will realize increased property tax revenues without having to raise tax rates.

Studies have indicated that parks in urban and populated suburban areas comprise 3% to 8% of the land area, and sometimes increase the value of a nearby home up to 15% of the value of the home (Anton 2005), while natural parks have the potential to contribute as much as 20% percent to the value of nearby properties (Lutzenhiser and Netusil 2001). This can be compelling information for future planning efforts.

5.2 Reducing Infrastructure Costs and Generating Ecosystem Services

Open space preservation can reduce infrastructure costs and save taxpayers money. The cost of providing public services (e.g. road repairs and schools) to residential development, particularly low-density development away from municipal centers, greatly exceeds the tax revenues generated by those residences (Shibley and Hovey 2003). Thus, as uncontrolled development expands, additional financial demands are imposed upon taxpayers. Protecting open spaces, instead of turning them into sprawling residential developments, is a smart growth strategy that can reduce the negative economic impacts of sprawl.

Protected open spaces also provide ecosystem services, i.e., services that are provided by the natural processes in intact ecosytems, e.g., improved water quality, flood control, and the pollination that is so critical for agriculture. A

recent Trust for Public Land study, "The Economic Benefits of New York's Environmental Protection Fund," found that every dollar invested in conserved land returned seven dollars of economic value in ecosystem services (Trust for Public Land 2012). Open space provides these services at much lower costs than would be required for engineered infrastructure, such as storm water infrastructure. Therefore, protecting open spaces and the ecological services they provide is another way to reduce costs and save taxpayer money.

5.3 Providing Outdoor Recreation Opportunities

Many outdoor recreation activities require large, protected open spaces such as parks and nature preserves. Outdoor recreation has a direct economic impact. According to a 2012 study by the Outdoor Industry Association, outdoor recreation generates $646 billion in consumer spending per year in the United States. This spending is on outdoor recreation products, as well as trips and travel associated with outdoor recreation. Outdoor recreation spending generates approximately 6.1 million U.S. jobs, $39.9 billion in federal tax revenue, and $39.7 billion in state/local tax revenue (Southwick Assoc. 2012). In an earlier study, the Outdoor Industry Foundation estimated that active outdoor recreation in New York State supports 130,000 jobs in the state, generates nearly $800 million in annual state tax revenue, and produces $11.3 billion annually in retail sales and services across the state (Outdoor Industry Foundation 2006). One specific study in Ulster County found that visitors to three nature preserves had a total annual impact of $12.3 million on local economies (Trust for Public Land 2012).

Outdoor recreation can also encourage conservation. In addition to the economic benefits mentioned above, hunting and fishing licenses help pay for many conservation activities.

In Canada, much of the impetus for Niagara Escarpment conservation efforts is influenced by the public's appreciation for the Bruce Trail. This walking trail follows the escarpment through Ontario, from Niagara Falls to Bruce Peninsula National Park, and is as iconic as the Appalachian Trail in the United States. Bruce Trail user groups helped advocate for the creation of the Niagara Escarpment UNESCO World Biosphere Reserve, and user groups continue to actively work to protect the escarpment. An example of this commitment and community involvement was the Leading Edge Conference held in the fall of 2013 near St. Catharines in Ontario. More than 200 professionals and community members attended the conference to discuss research, ecological monitoring, conservation, and creating sustainable communities on Ontario's Niagara Escarpment.

5.4 Improving Public Health

Providing outdoor recreation opportunities on protected open space can have significant health benefits for communities. Exercise and active lifestyles help individuals control their weight and maintain fitness while preventing a variety of diseases and improving mood and psychological wellbeing for people of all ages. In New York State, two of the three most popular activities for residents aged 60

or more include relaxing in the park and walking for pleasure (New York State Office of Parks 2007). Providing recreational opportunities for older residents will continue to grow in importance as the portion of the population in this age range continues to increase. For youth, there is much evidence that children are spending less time outside and that this is contributing to the rise of childhood and adolescent obesity rates and associated health problems. Studies show that children who play and learn outside not only are physically healthier, but they have stronger immune systems, less stress, fewer sleep disorders, a more positive outlook on life, improved test scores, and greater conflict resolution skills (New York State Office of Parks 2009).

5.5 Preserving Viable Farmland

Protecting farmland and working farms has significant economic benefits, for both communities and for farmers themselves. Niagara County farms generated more than $103 million in income from farm products in 2007 (USDA 2007). This income spills over to boost income for non-farm business. The State Comptroller estimates that every dollar of farm-related income generates another dollar of non-farm income (NYS Office of the State Comptroller 2010). Farms multiply jobs, too. Every job on a dairy farm creates another 1.24 jobs in other businesses (NYS Office of the State Comptroller 2010). A study from Cornell Cooperative Extension concluded that agriculture gave a greater boost to the local economy than all the other industries examined, including construction, services, retail and wholesale trade, manufacturing, finance, insurance, and real estate. Agriculture's regional economic impact and strength were recognized when the Western New York Regional Economic Development Council targeted it for future investment of state funds (WNY Regional Economic Development Council 2011). Protecting farmland and working farms will help ensure that Niagara County municipalities can successfully compete for these and other investment dollars.

Protecting farmland can also help municipalities put their budgets in the black by keeping costs down. On average, farms cost less in infrastructure services than other land uses, and actually generate a net surplus in tax revenues for municipalities. A study by the American Farmland Trust showed that for every tax dollar received from farms and open land, municipalities spent only 36 cents to provide services, a net surplus of 64 cents. In contrast, for every tax dollar received from residential development, municipalities spent $1.32 to provide services, a net loss of 32 cents. This net loss must be offset somehow, often by increasing taxes (American Farmland Trust 2010). Studies show that tax rates tend to rise more quickly in communities with less protected farmland and open space than in communities that have prioritized farmland protection (American Farmland Trust 2010).

In addition to the direct tax benefits that farms provide for the communities in which they are located, they also provide environmental and health benefits. The fields, hedgerows, and wood lots on well-managed farms provide natural drainage and water filtration, lessening the need for levee systems and reducing the load on

sewage treatment plants to manage storm water, and provide natural filtration for ground and surface water supplies. Consumers living in communities with abundant local farms growing a diversity of crops benefit by having direct access to the fresh and healthy food. An improved diet can have a positive impact on health by helping prevent obesity, heart disease, high blood pressure, type 2 diabetes and some types of cancer.

Municipalities can take advantage of funding programs that help pay for farmland protection. State and federal farmland protection programs pay agricultural property owners for the value of the property's development rights. The owner can continue to farm the land, lease it out, or sell it, but no one can use the land for residential or commercial development. Farmland protection programs give farmers a way to get some of the money out of their land without losing their livelihood or the land. Nearly half of the farmers participating in the federal farmland protection program use the money to expand their operations, buy more land, purchase equipment and vehicles, invest in cost-saving energy facilities, or strengthen their conservation management practices (Esseks, Schilling, and Hahn 2013). When farmers put money back into their farms, the community benefits too, from a stronger local economy, cleaner environment, and greater access to fresh food.

Niagara County municipalities lag behind when it comes to taking advantage of farmland protection programs. Within the Buffalo-Niagara area, all of the land that has been protected with state and federal funding programs are located in Erie County. Amherst, Clarence, Elma, Marilla and, most recently, Eden, have all established robust programs to protect farmland. With assistance from the Western New York Land Conservancy, these five municipalities have protected more than 3,000 acres of farmland (Table 5.5-1).

Table 5.5-1 Protected Farmland in the Buffalo-Niagara Region

Municipality	Acres
Amherst	784.0
Clarence	1226.7
Eden	192.0
Elma	61.0
Marilla	768.1
Total	**3,031.8**

Green violet (*Hybanthus concolor*), Lockport

Open emergent marsh, Lockport

Viola spp., Lewiston

Red-backed salamanders hiding under rock (*Plethodon cinereus*), Lockport

Alvar community, Cambria

Stone wall demarcating property line, Lockport

6 Niagara Escarpment Conservation Strategy

The conservation strategy for the portion of the Niagara Escarpment lying within Niagara County was developed based on the findings of this study and the input from local, regional, and state stakeholders. The results will help everyone involved in conservation efforts understand the ecological and historical resources existing today and guide them as they plan future development and devise further conservation efforts.

6.1 Goals

The authors and contributors to this report developed four goals for the conservation of the Niagara Escarpment, each of them achievable if stakeholders—government entities, landowners and interested individuals, and organizations from across the spectrum—agree to take on the responsibility and challenge of realizing these goals.

Goal 1: Conserve critical natural and cultural resources, areas of high biodiversity and special sensitivity, and areas important to ecological connectivity.

Goal 2: Restore ecologically significant areas.

Goal 3: Strengthen the regional economy.

Goal 4: Provide the public with access to and more opportunities for passive recreation and education.

6.2 Strategies

For each goal, the Niagara Escarpment Legacy Project recommends a set of strategies that will help address the goal as well as the organization(s) that might be best suited to implement the strategy. Potential funding sources are identified for each strategy and are presented in further detail in Appendix H.

Goal 1: Conserve Critical Natural and Cultural Resources, Areas of High Biodiversity and Special Sensitivity, and Areas Important To Ecological Connectivity.

Strategy 1-1: *Develop a local Niagara Escarpment Friends group that will work to conserve the ecologically significant and cultural resources of the escarpment.*

In order to conserve the ecologically and culturally significant resources of the escarpment it is essential that a coordinating group, e.g., Friends of the Niagara Escarpment group, be developed to continue the work of this Project and be the "champion" of the escarpment into the future. There is a significant opportunity for local residents and organizations to work together to further the goals set forth in this conservation strategy. The members of the Friends of the Niagara Escarpment group could include interested private citizens and representatives from organizations and agencies including but not limited to the following:

- BOCES conservation programs
- Bond Lake Environmental and Beautification Committee
- Buffalo Audubon Society
- Buffalo Museum of Science
- Buffalo Niagara Riverkeeper
- Citizens Campaign for the Environment - Western New York/Southern Tier Chapter
- Citizens' Environmental Coalition - Western New York Office
- Clean Communities of Western New York
- Haudenosaunee Environmental Task Force
- Keep Western New York Beautiful
- League of Women Voters of Buffalo/Niagara
- Lewiston Historical Society
- Local garden clubs
- Local schools/universities
- Lockport Canal Task Force
- Local municipalities
- Main Street America
- Municipal Historical Societies
- National Park Service, National Heritage Program (Erie Canalway National Heritage Corridor and Niagara Falls National Heritage Area)
- Nature Sanctuary Society of Western New York, Inc.

- New York Center for Agricultural Medicine and Health (NYCAMH)
- New York Rivers United
- Niagara Community Action Program, Inc.
- Niagara County Center for Economic Development
- Niagara County Community College Environmental Task Force
- Niagara County Environmental Management Council
- Niagara County Farm Bureau
- Niagara County Historical Society
- Niagara County Soil and Water Conservation District
- Niagara Frontier Botanical Society
- Niagara Frontier Wildlife Habitat Council
- Niagara History Center
- Niagara River Anglers Association
- Niagara Wine Trail
- NYS Office of Parks, Recreation & Historic Preservation
- NYS Natural Heritage Program
- Residents for Responsible Government
- Rollin T. Grant Gulf Wilderness Park Citizens' Advisory Committee
- Rotary clubs
- Sierra Club Niagara Group
- Sportsmen's clubs
- Tuscarora Nation
- WNY Climate Action Coalition
- Western New York Environmental Alliance
- Western New York Land Conservancy

Strategy 1-2: *Identify additional environmentally sensitive areas.*

As noted in Section 4.1, this study has identified environmentally sensitive and important areas. Evaluation of additional environmentally sensitive areas will require additional surveys, which could be coordinated with the Friends of the Niagara Escarpment group. This process would evaluate the following attributes for each site being considered:

- Unique geology (exposed rock faces, talus slopes)
- High biodiversity

- Rare species (plants, amphibians, birds)
- Unique or rare ecological communities
- Water features including wetlands, seeps, vernal pools and headwater streams
- Ecological connectivity
- Important cultural/historical features.

Once these additional sites are identified, they can be evaluated for future preservation, restoration, or public access/use. The evaluation should also consider:

- Landowner interest
- Connection to existing preserved areas
- Presence of environmental hazards.

Strategy 1-3: *Improve stewardship of existing conserved areas.*

Engaging the public in the care of conserved areas is critical to the success of the conservation of the escarpment. Stewardship requires a multi-faceted approach and can involve people of diverse talents, interests, and resources. Some of the ways stewards may contribute include enhancing public access, removing and controlling invasive species, maintaining and improving trail systems, restoring native plants, and coordinating public education efforts regarding stewardship. As members of the public visit preserved areas, stewardship will increase as well.

Improved stewardship will involve informing and educating landowners as well as maintenance personnel from county and town parks and disseminating educational materials. Numerous educational materials already exist and are available from agencies such as the National Resource Conservation Service, the Cornell Cooperative Extension of Niagara County, and the WNY Partnership for Regional Invasive Species Management (PRISMs).

Many resources are available to assist public and private landowners in the development of site-specific control and management plans (ISCMPs) to better protect sensitive habitats from invasive species. The NYS Invasive Species Management Strategy 2011 describes in detail approaches to creating ISCMPs in New York State. The NYS PRISMs provide information for the public and private sectors about invasive plant ecology and how to develop local ISCMPs. Currently, eight PRISMs exist or are forming across New York State. Each PRISM is tasked with the following management functions:

- Coordinating partner efforts
- Recruiting and training citizen volunteers
- Identifying and delivering education and outreach

- Establishing early detection monitoring networks
- Implementing direct eradication and control efforts.

PRISMs allow private citizens and interested organizations to work together to protect New York's environment by managing invasive species. The Western New York PRISM was funded in 2013 as a resource for the eight-county Western New York region, including Niagara County. In addition, local invasive species initiatives, such as NYSDEC's Reinstein's Woods Garlic Mustard Challenge, which are currently engaged in educating the public about conservation lands throughout Western New York, can be expanded to include areas specific to the escarpment.

Public parks with trail systems and considerable public access, such as Artpark State Park, The Rollin T. Grant Gulf Wilderness Park, Bond Lake Recreation Area, Lockport Nature Trail, and Royalton Ravine represent excellent opportunities to engage the public in stewardship. Many of these areas are already threatened by invasive species, such as the emerald ash borer, and so serve as excellent beginning points for public education about their dangers and their potential for widespread damage if not controlled. Each park should include resource stewardship projects in their management plans, and enlist the help of WNY PRISM.

Strategy 1-4: *Conserve priority properties using a variety of voluntary mechanisms.*

Land conservation efforts should be employed for sites along the escarpment that have been identified as priority sites based on the evaluation system for ecologically and culturally significant areas detailed in Strategy 1-2. The detailed information regarding the high priority sites that were identified from this Project are currently being assessed by the Land Conservancy. Support for land conservation could be enhanced through a project that would highlight how the voluntary conservation of privately owned agricultural land would benefit the landowner as well as the community.

Property acquisitions, conservation easements, and assisted transactions are three ways that land trusts work to conserve priority lands.

Property Acquisition
The most straightforward way to conserve a high priority property is through property acquisition—transfer of the land from one owner to another.

Property acquisitions for conservation purposes typically occur through a property purchase or by donation. When selling a property, the landowner receives payment for the property. When donating a property, the landowner may be able to claim a tax-deductible charitable donation if the donation meets federal tax code requirements. The landowner may also authorize a 'bargain sale' by selling the property for less than its appraised value and may be able to claim a tax

deductible charitable donation for the difference in appraised value and sale price. In order to receive a tax deduction, the donation must be made to a not-for-profit organization or a government.

Several government agencies and not-for-profit organizations own property in Niagara County for conservation and recreational purposes and could partner with interested property owners on acquisitions of high priority properties. These include the following:

- Buffalo Audubon Society (North Tonawanda Audubon Preserve)
- Cities, towns, and villages that own and operate local parks
- Western New York Land Conservancy (Niagara Escarpment Preserve and North Tonawanda Audubon Preserve—co-held with Audubon).
- NYS Department of Environmental Conservation (two wildlife management areas – Hartland Swamp and Tonawanda)
- Niagara County (Oppenheim, Krull, Bond Lake, and Royalton Ravine)
- NYS Office of Parks, Recreation, and Historic Preservation (11 state parks – Niagara Falls, De Veaux Woods, Whirlpool, Devil's Hole, Reservoir, Artpark, Joseph Davis, Fort Niagara, Four Mile Creek, Wilson-Tuscarora, and Golden Hill).

Conservation Easement
A conservation easement is a legal agreement between a landowner and a land trust or governmental agency that permanently limits uses of the land in order to protect its conservation values. Conservation easements can help protect working farms, watershed areas, wetlands, wildlife habitat, open space, and the scenic beauty in a region.

When landowners place a conservation easement on their land, they permanently give up some of the rights associated with the land. For example, they might give up the right to build additional residences, while reserving the right to farm. The conservation easement allows a landowner to continue to own and use the land and to sell it or pass it on to heirs. Future owners will be bound by the easement's terms and the land trust or government agency is responsible for making sure the easement's terms are followed.

Conservation easements offer great flexibility. An easement on property containing rare wildlife habitat might prohibit any development, while an easement on a farm might allow continued farming and the addition of agricultural structures. An easement may apply to all or a portion of a property, and need not require public access.

Easement values vary greatly; in general, the highest easement values result from very restrictive conservation easements on tracts of open space under intense

development pressure. In some jurisdictions, placing an easement on a property may also result in property tax savings.

A conservation easement can be essential for passing undeveloped land on to the next generation. By removing the land's development potential, the easement typically lowers the property's market value, which in turn lowers the potential estate taxes. Whether the easement is donated during life or by will, it can make a critical difference in one's heirs' ability to keep the land intact.

Sometimes land trusts or governmental agencies have funding available to purchase development rights to establish a conservation easement, and the land owner is reimbursed in full or in part for the value of the development rights on their land. This is known as "purchase of development rights." Alternatively, a land owner donates a conservation easement to the land trust or government agency. A conservation easement donation that meets federal tax code requirements can qualify as a tax-deductible charitable donation. For income tax purposes, the value of the donation is the difference between the land's value with the easement and its value without the easement. New York State property tax credits are also now available to conservation easement donors.

In Niagara County, the most active land trust is the Western New York Land Conservancy, with four properties and 234 acres protected through conservation easements.

Assisted Transactions
Some land trusts, like the Land Conservancy, assist landowners and other conservation organizations or governmental agencies with land conservation projects. In these instances, the land trust may help identify priority properties for conservation and work with the landowner to find the most appropriate conservation method. If a property is to be purchased, the land trust may assist finding the right owner. If a conservation easement is to be placed on the property, then the land trust may assist in finding a partner to hold the easement. The land trust may be able to help both parties through the transaction or easement process and may even be able to help fundraise for the project.

Strategy 1-5: *Work with municipalities to incorporate conservation of the escarpment into their land use planning.*

The Town of Cambria's current zoning ordinance regulates what can be built along the escarpment and includes requirements that houses be built more than 80 feet from the northern and southern edge of the escarpment, that all buildings in the Escarpment District be subject to a permitting process, and that general clearing of trees and top-cutting of trees is prohibited. Currently no other town in the Niagara County portion of the escarpment has zoning like this, although the Niagara Communities Comprehensive Plan 2030 addresses the need to protect and preserve the Niagara Escarpment (Niagara County 2009).

Tools that can be used by municipalities to improve land management along their portion of the escarpment include updating town/village comprehensive plans to include an overlay district that considers land uses within the escarpment and/or revising zoning to regulate activities within the escarpment. The development and implementation of such tools would require significant effort to educate the communities about the benefits of such an ordinance and approval of the landowners as well as the municipal leaders. A potential action of the Friends of the Niagara Escarpment could be to coordinate meetings with municipal leaders to discuss the benefits of conservation and issues surrounding preservation while helping them understand how best to address both in their individual municipalities.

Strategy 1-6: *Work to obtain voluntary designations for historic resources when appropriate, as well as an international, national, or statewide designation for the entire escarpment that recognizes its ecological and cultural values and that promotes better stewardship of its resources.*

State, federal, and international designations should be considered for the United States portion of the escarpment. The identification of the appropriate designation and efforts to obtain such designation could be a function of the Friends of the Niagara Escarpment group. Possible designations include:

- Extension of the UNESCO Biosphere Reserve from Canada into the Niagara County National Heritage Area/Corridor
- Extension of National Heritage Areas
- National Historic Landmark/District
- State and National Register of Historic Places
- State or National Scenic Byway.

A designation for the escarpment could help elevate the escarpment's importance and increase awareness of it, potentially bringing in new resources. The most feasible type of designation would be one that is voluntary, non-regulatory, and involves input from landowners.

Goal 2: Restore Ecologically Significant Areas.

Strategy 2-1: *Identify ecologically significant areas in need of restoration.*

The ecologically significant areas identified in Strategy 1-2 should be evaluated for restoration need based on historical loss of habitat, presence of invasive species, or encroachment from nearby development. The majority of the restoration opportunities along the escarpment consist of areas where disturbance has led to invasive species concerns. Once priority sites are identified, local, state and federal agencies can be involved through the identification of potential funding sources. A full restoration plan should be developed for each priority site.

One example of an ecologically significant area in need of restoration is at Royalton Ravine County Park, which has significant issues with invasive species throughout the park. As additional studies along the escarpment are conducted, these studies should further identify areas (public and private) that are in need of restoration.

Strategy 2-2: *Identify ecologically significant areas that are contaminated and prioritize cleanup of these sites.*

As discussed in Section 3.7.4.7, sites on the escarpment that have been identified as contaminated are currently in various stages of cleanup. As additional sites with known contamination are identified, they should be prioritized for cleanup, based on the available state and federal funding for such work. Any work associated with contaminated sites requires collaboration with state and federal agencies, as well as other potential funders, to obtain resources for clean up. Any cleanup activities on contaminated sites could also include potential for public access once complete.

Although most of the identification and prioritization of contaminated sites is the responsibility of a jurisdictional state or federal agency (NYSDEC and EPA), as communities become aware of issues associated with these contaminated areas, municipal leaders and residents should collaborate in order to advocate for cleanup of their site. An example of this is the recent flooding along the Superfund site at Eighteen Mile Creek in Lockport. Public concerns were heard by the EPA, and remediation and a resident relocation plan was proposed and is being implemented.

Strategy 2-3: *Develop outreach materials for landowners to promote best management practices for restoring habitat, soils, and water quality and for preventing the spread of invasive species.*

General restoration efforts should also include outreach to landowners regarding the best management practices that they can implement for restoring and protecting their habitats, controlling erosion, maintaining water quality, and controlling invasive species. A Friends of the Niagara Escarpment group might implement this outreach by sending postcards/flyers that detail existing land management resources from the National Resource Conservation Service, Cornell Cooperative Extension of Niagara County, or PRISMs. As discussed above under Strategy 1-3, the local Western New York PRISM coordinates invasive species management using regional partners (educational institutions, not-for-profit organizations, and local citizens), recruiting and training of citizen volunteers, and identifying and delivering educational and outreach materials. PRISMs are a great way for private citizens and interested organizations to help manage invasive species and protect New York State’s environment.

Goal 3: Strengthen The Regional Economy.

Strategy 3-1: *Coordinate with local, regional, and state tourism organizations to promote the Niagara Escarpment as a destination for visitors, including the development of Niagara Escarpment brand.*

Promoting and enhancing existing ecological, recreational, historical, and agricultural resources on the escarpment will strengthen the economy of the larger Niagara region. Tourism opportunities could be used as a significant economic resource for the larger Niagara region. Developing targeted tourism materials could draw visitors from nearby Niagara Falls and Buffalo farther into the region by extending their visits to include trips along the Niagara Wine Trail, Erie Canal, other historical areas, and to publicly accessible farms and natural recreation areas.

Many organizations are currently working locally to enhance tourism and provide public opportunities for their specific resource along the escarpment. By joining forces these organizations could accelerate the economic impact of tourism along the escarpment. The Niagara Communities Comprehensive Plan (Niagara County 2009) developed a Destination Corridor Concepts Map, which includes a Niagara Escarpment Scenic Corridor. Although the corridor is only proposed, it is possible that it could be implemented with the support of the Friends of the Niagara Escarpment group. Additional organizations that are leading promotional efforts include but are not limited to the following:

- Buffalo First
- Bond Lake Park Environmental and Beautification Committee
- Local garden clubs
- Lockport Canal Task Force
- Main Street America
- Niagara History Center
- Niagara Wine Trail
- Niagara County Farm Bureau
- Rollin T. Grant Gulf Wilderness Park Citizens' Advisory Committee.

The more the public becomes familiar with the escarpment, the easier it will be to brand the Niagara Escarpment as synonymous with natural beauty, recreation, tourism, and the ecological diversity that makes the area so unique.

Strategy 3-2: *Work with local farmers and municipalities to identify and embrace opportunities to expand and promote existing agricultural enterprises along the escarpment.*

An essential component of the economy along the escarpment is the increase in agricultural enterprises discussed in Section 3.7.2. Supporting these operations helps identify new opportunities to bring local agricultural products to consumers through farmers markets, and local restaurants. Field & Fork Network is currently advocating this effort throughout the Western New York region "to create a practical economic engine for local, sustainable agriculture and to provide our region with access to fresh, healthy food" (Field & Fork Network [n.d.]). The proposed Friends of the Niagara Escarpment group could work with the Field & Fork Network, the Land Conservancy, and the Niagara County Farm Bureau, as well as directly with agricultural landowners to identify ways to expand and promote the agricultural economy along the escarpment.

Strategy 3-3: *Collaborate with and provide information to the public and elected officials on the economic benefits of open space.*

Open spaces such as parks, greenways and parkways, preserves, farmland, forests, and undeveloped land can all enhance the character and value of a community. In addition, there are economic benefits of conserving open spaces such as reduced infrastructure costs for municipalities, along with increased property values and associated higher property tax revenue for local municipalities. Open spaces also offer economic benefit 'ecosystem services' such as flood control, reduction in air pollution, improved water quality, increase in wildlife habitat, alleviation of traffic congestion, and encouragement of healthy lifestyles.

Organizations such as the Trust for Public Land and the Land Conservancy, and eventually, a Friends of the Niagara Escarpment group, can help municipalities understand how open space programs work and explain the benefits they provide. They can also help municipalities identify funding if they wish to incorporate open space preservation into their long-range planning.

Goal 4: Provide the Public with Access to and More Opportunities for Recreation and Education.

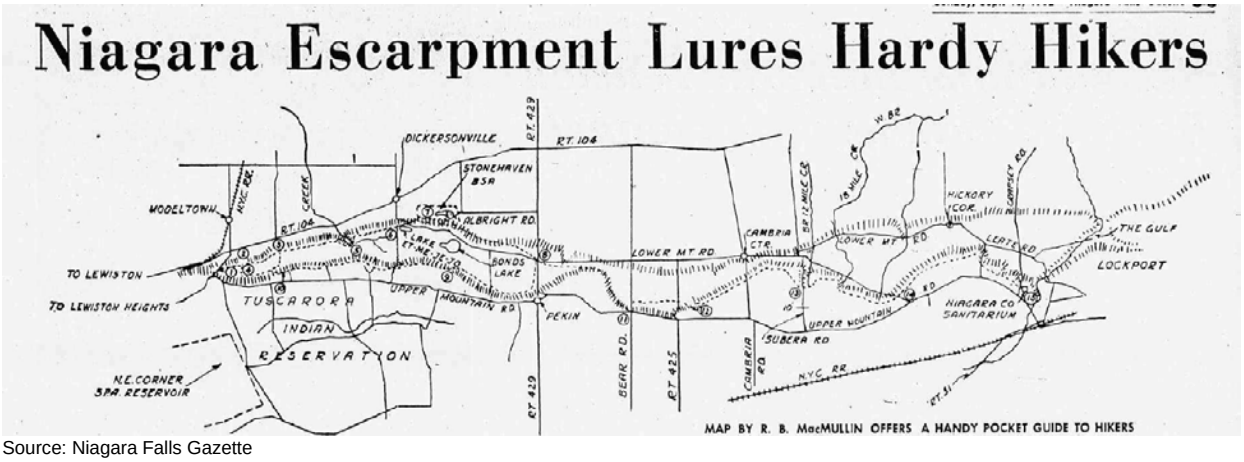
Strategy 4-1: Identify areas for new or enhanced access to existing public sites by developing trail networks on abandoned railways, utility corridors or informal trails.

Existing public access along the escarpment is detailed in Section 3.7.1. There are opportunities for additional public access along the escarpment that is compatible with ecological goals and that address the interests and concerns of landowners as well. In Canada, much of the impetus for escarpment conservation efforts came from the Bruce Trail. This walking trail follows the escarpment through Ontario, from Niagara Falls to Bruce Peninsula National Park and is as iconic as the Appalachian Trail in the U.S. Bruce Trail user groups helped advocate for the creation of the Biosphere Reserve and still work to protect the escarpment.

Several local organizations are currently working to improve access and awareness of local public parks and recreational areas including:

- Bond Lake Park Environmental and Beautification Committee
- Lockport Canal Task Force
- New York Geographic Alliance
- Niagara County Farm Bureau
- Niagara History Center
- Rollin T. Grant Gulf Wilderness Park Citizen's Advisory Committee
- Western New York Land Conservancy.

Some other possibilities for increased public access sites are abandoned railroad rights-of-way. For example, the Town of Pendleton has developed the Pendleton Rail Trail using part of the former Lehigh Valley Railroad bed that will link Pendleton with the Erie Canalway Trail (Parks & Trails New York [n.d.]). Several local landowners who are stakeholders in this Project indicated that the "Hojack Line" or the Rome, Watertown, and Ogdensburg Railroad (assumed to be the rail line on the Niagara Escarpment trail map photo) that once connected Niagara Falls to Oswego has active equestrian trails and might be a candidate for expanded public access. Many of these trails are undocumented and on private land, so significant outreach to landowners and municipalities would be necessary to achieve this outcome. Such a project has already been identified within the Niagara Communities Comprehensive Plan, where a multi-use trail labeled Escarpment Corridor Preservation is proposed on a General Land Use Concepts map.



Source: Niagara Falls Gazette

Niagara Escarpment trail map by R.B. MacMullin, as printed in the Sunday, September 16, 1962 edition of the Niagara Falls Gazette.

Trails and footpaths that are known only to locals might form part of new hiking networks if the Friends of the Niagara Escarpment group or other advocates can

connect with them. For example, the *Niagara Falls Gazette* in September 1962 published an article "Niagara Escarpment Lures Hardy Hikers" that described a 15-mile hiking route from Lewiston to the former Niagara County Sanatorium (currently Mount View Hospital) on Upper Mountain Road in Lockport. The article indicated the location of some paths along this route, noting that it would be an arduous hike through some private land and cultivated fields, and permission would be needed before use. More research would no doubt turn up other such trails, waiting to be re-discovered and added to the network.

Landowners, public and private, still hold the key to public access, though. Reaching out directly to landowners to educate them about the importance of the escarpment is an essential step in securing more public access. New public access areas could involve connecting existing trails and conserving additional land. Geocachers, enthusiasts of the popular Internet-based, treasure hunt game, could provide further exposure to the escarpment's publicly accessible areas.

Funding for public access could be sought through the Niagara Greenway and the Niagara Power Authority as an extension of their work along the Niagara River, in order to expand its reach into the escarpment. Additionally, the 2010 Statewide Trails Plan (OPRHP 2010) indicates that while federal and state governments primarily fund trail projects, "the demand . . . greatly exceeds the available resources." The following are other potential funding sources, as identified in the Statewide Trails Plan:

- Safe, Accountable, Flexible, Efficient Transportation Equity Act
- Land and Water Conservation Fund
- National Recreation Trails Program
- Federal Highway Administration (multiple programs)
- Environmental Protection Fund (at state level).

Strategy 4-2: *Develop self-guided escarpment tours that include way-finding and interpretive signs.*

One way to increase public awareness and accessibility to the escarpment would be to develop and promote self-guided tours along the escarpment. These tours could identify key locations such as public parks/natural areas, agricultural (vineyards and farms), and historical sites relating to the Erie Canal, the Underground Railroad, and the War of 1812. Additionally, there could be a Niagara Escarpment garden tour or historic home tour like those taking place in communities throughout Western New York and Niagara County.

One such example of a self-guided tour that is currently in development by the Historical Association of Lewiston is the "Witness Tree" project. As discussed in Section 2.2, its intent is to develop a "Witness Tree" Project book that will include locations, photos, and stories of these 200-year-old trees that tourists

could use in a self-guided tour. These "living sentinels" will allow the public to learn the story of Lewiston's history along the Niagara Escarpment.

Similar efforts in other areas could allow the public to visit significant areas through the entire escarpment. The use of way-finding and interpretive signs could assist visitors in locating areas of interest, especially if the signs were placed at strategic locations along the escarpment. The signs could be located on high-traffic thoroughfares that cross the escarpment and run along it, including but not limited to the following sites, as previously proposed by the Land Conservancy for a scenic and interpretive trail (as shown in Figure 6.2-1):

A few proposed locations for potential Escarpment Trail signs:

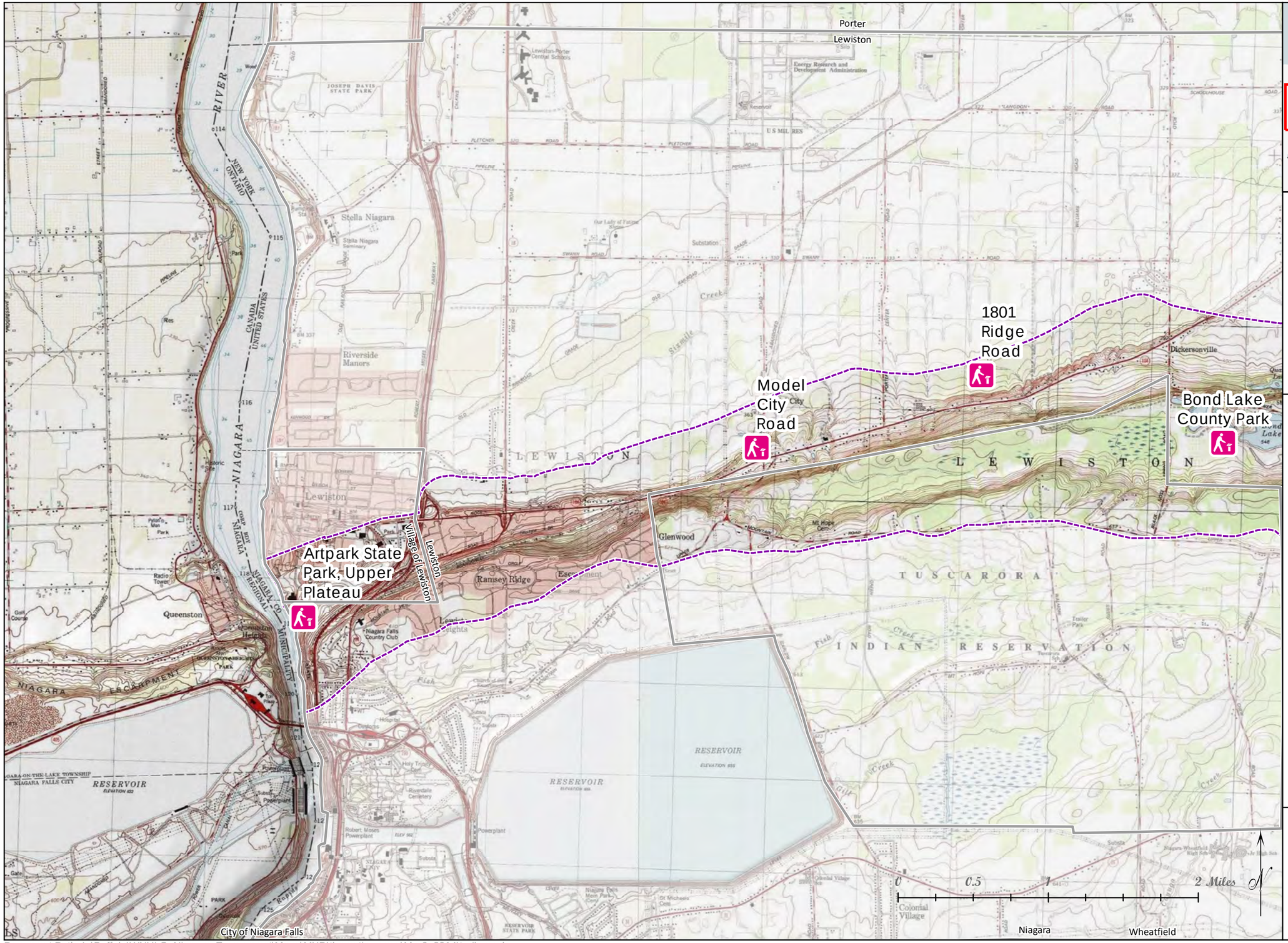
- Artpark State Park, Upper Plateau, Village of Lewiston
- Model City Road near the corner of Route 104 near the Tuscarora Nation Territory
- 1801 Ridge Road Farm, Town of Lewiston (1/2 mile west of Dickersonville Road)
- Bond Lake County Park, Town of Lewiston
- Pekin, Near Pekin Garage, Upper Mountain Road and Route 429, Town of Lewiston
- Near Mt. View Cemetery (3115 Upper Mountain Road, 1000 feet east of Route 429), Cambria
- Near Hillside Cemetery, Cambria (Cambria Road between Upper and Lower Mountain Roads)
- Blackman Road, Cambria (south of Thrall & Lower Mountain Roads intersection)
- Lockport Historical Society, Town of Lockport (Lower Mountain Road at Budd Road)
- Niagara Escarpment Nature Preserve, Town of Lockport (Leete Road)
- Rollin T. Grant Gulf Wilderness Park, City of Lockport
- Royalton Ravine Park, Town of Royalton.

Existing organizations such as the Niagara County Farm Bureau, Niagara Wine Trail, Niagara Historical Society, and Niagara County Parks department, as well as a potential Friends of the Niagara Escarpment group, could help develop and promote these self-guided tours. Additional support and potential funding could come from the Niagara Greenway and the Niagara Power Authority.

Strategy 4-3: *Develop a public education program promoting the escarpment's geological, ecological, and historical significance.*

The story of the escarpment, from a geological perspective, could form an integral part of the public's appreciation of the area. The development of educational materials for students K-12, coupled with field trips, trips guided by volunteers from the Friends of the Niagara Escarpment group, and self-guided tours with signs along the way, would provide young people with this appreciation and familiarity at an early age. Art projects inspired by the escarpment and art installations would help create a sense of place and develop interest among students, visitors, and local residents as well.

Public schools throughout Western New York and local colleges and universities such as Niagara University, Niagara County Community College, Buffalo State College, and the University at Buffalo could partner in these ventures.


Porter
Lewiston
1801 Ridge Road
Model City Road
Bond Lake County Park
Artpark State Park, Upper Plateau
Village of Lewiston
City of Niagara Falls
Niagara
Wheatfield
Stella Niagara
Riverside Manors
Queenston
Glenwood
Ramsey Ridge
Dickersonville
Lewiston-Porter Central Schools
Energy Research and Development Administration
Joseph Davis State Park
Stella Niagara Seminary
Our Lady of Fatima
Substation
U S MIL RES
Reservoir
Creek
Sixmile
Lewiston
Niagara Falls Country Club
Riverdale Cemetery
Robert Moses Powerplant
Powerplant
Colonial Village
Mt Hope Cem
Trailer Park
Trailer Park
Niagara Wheatfield High Sch
Sanborn
Gate
Radio Tower
Golf Course
Pylon Mon Park
Historic Site
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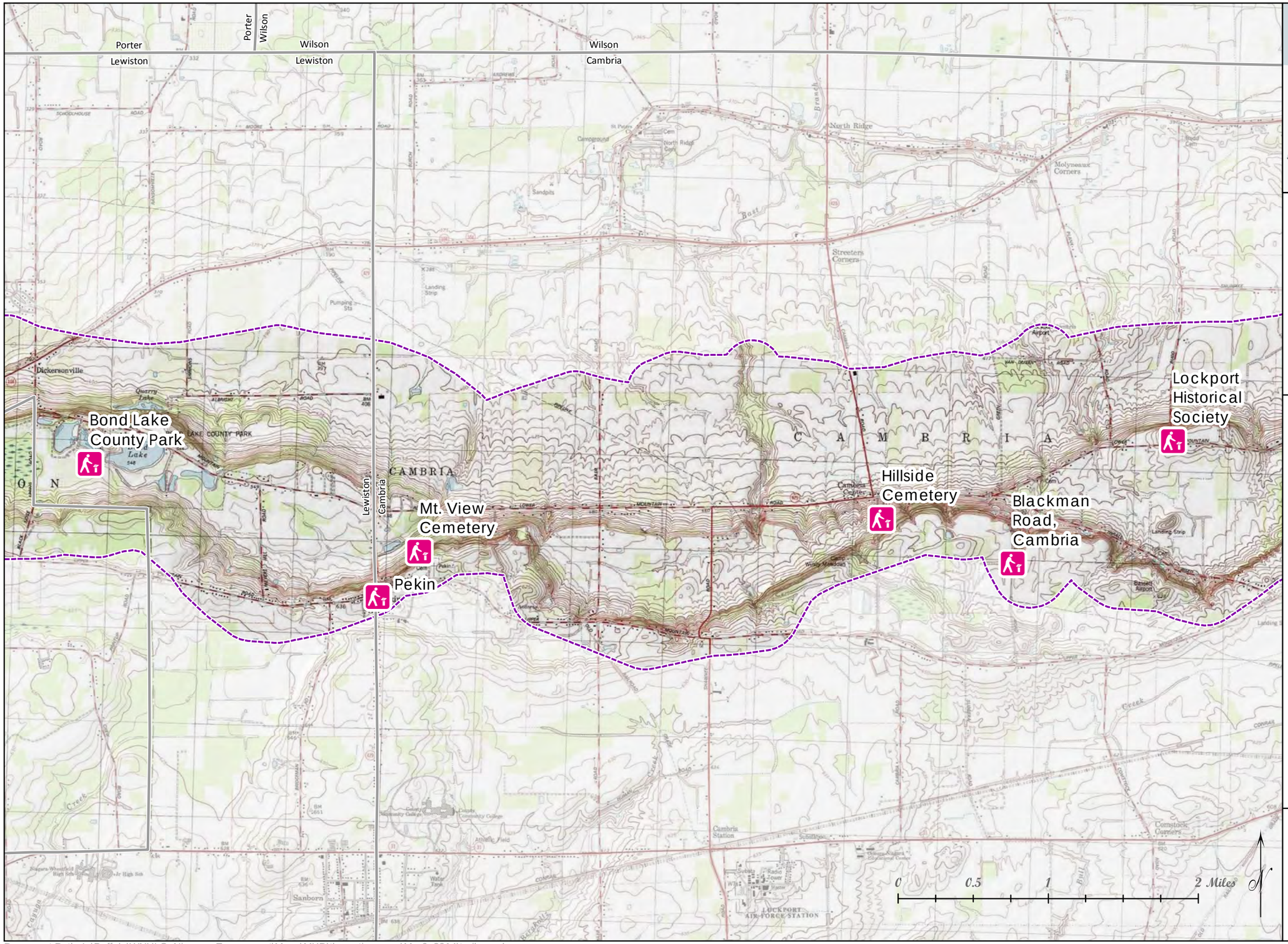

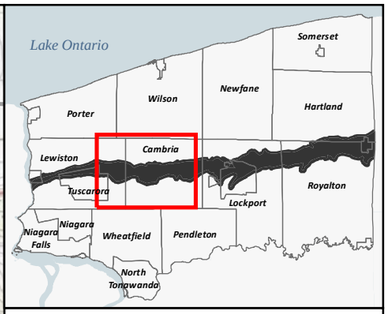

Figure 6.2-1

Self-Guided Scenic and Interpretive Trail Sites Proposed by the Western New York Land Conservancy

Proposed Trail

Niagara Escarpment Study Area

Data Sources:
Topo: USGS publication dates: Variable

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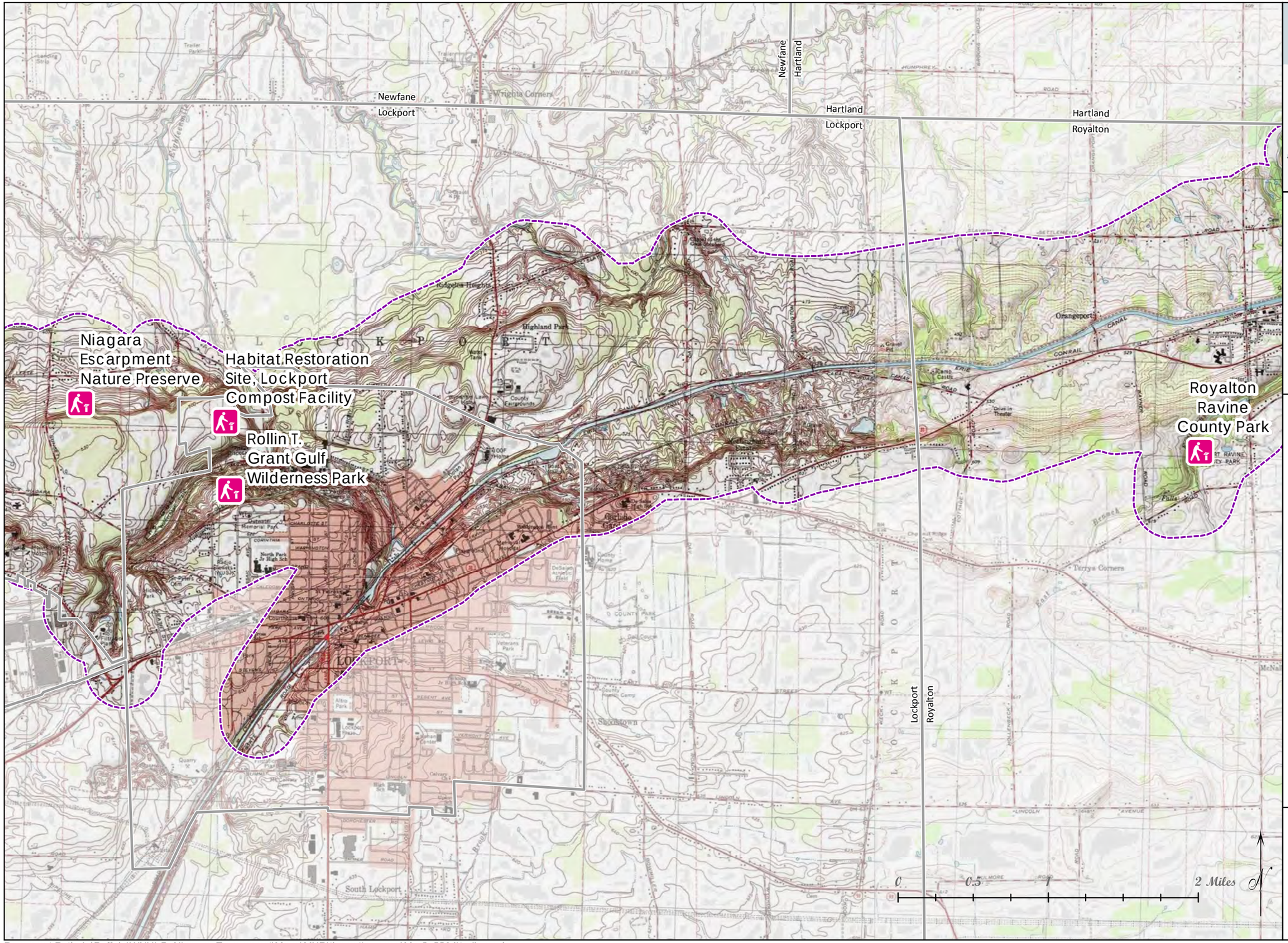

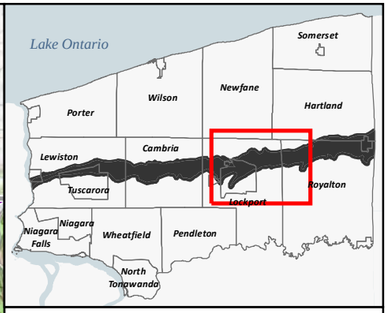

Figure 6.2-1

Self-Guided Scenic and Interpretive Trail Sites Proposed by the Western New York Land Conservancy

Proposed Trail

Niagara Escarpment Study Area

Data Sources:
Topo: USGS publication dates: Variable

Document Path: L:\Buffalo\WNYLC_Niagara_Escarpment\Maps\MXD\thematic_maps\Mar6_2014\trails.mxd

Talus cave, Cambria

Private road along escarpment, Cambria

Dairy farm along escarpment in Gasport

Red-backed salamander (*Plethodon cinereus*), Lockport

Silky dogwood (*Cornus amomum)*, Lockport

Carpet of white trillium (*Trillium grandiflorum*), Lewiston

7 Epilogue

Conservation, preservation, restoration—three words that have appeared often in the preceding pages—define the most important word in this report's title: "Legacy." Tucked into the lengthy pages of scientific field survey results, social history, strategies, and goals is an underlying message: the Niagara Escarpment deserves to be the legacy that we leave to future generations. Formed from bedrock eons ago, and now the sturdy host to richly populated ecological communities of a broad biodiversity, this geologic marvel is still susceptible to irreversible damage by unfettered development, poorly considered land use, and an invasion of unwanted species. If this study has been successful, it will have shown all the stakeholders—from individuals who simply enjoy the peace of a public park to landowners, governments, not-for-profit organizations, tourists, citizens of residential areas, history buffs, Native Americans, farmers, leaders of commerce and industry—that protection of the escarpment is in everyone's common interest.

8 References

Andrle, Robert F. and Janet R. Carroll. 1988. *The Atlas of Breeding Birds in New York State*. Cornell University Press.

Anton, Paul A. October 2005. The Economic Value of Open Space: Implications for Land Use Decisions. http://www.embraceopenspace.org/index.asp?SEC=6F5B2EF3-C9B6-49B2-989B-DE2FBA9F4F13&Type=B_LIST. Accessed November 4, 2013

American Farmland Trust. 2010. "Farmland Information Center Fact Sheet: Cost of Community Service Studies." http://www.farmland.org/documents/Cost-of-Community-Services-08-2010.pdf. Accessed January 2014.

Bernstein, Peter. 2005. "Wedding of the Waters." New York.

Blehert, D. S., A. C. Hicks, M. Behr, C. U. Meteyer, B. M Berlowski-Zier, E. L. Buckles, J. T. H. Coleman, S. R. Darling, A. Gargas, R. Niver, J. C. Okoniewski, R. J. Rudd, and W. B. Stone. 2009. Bat white-nose syndrome: an emerging fungal pathogen? *Science* 323:227.

Brett, C.E., D.H. Tepper, W.M. Goodman, S.T. LoDuca, and B. Eckert. 1995. *Revised Stratigraphy and Correlations of the Niagaran Provincial Series (Medina, Clinton, and Lockport Groups) in the Type Area of western New York*. U.S. Geological Bulletin 2086. U.S. Geological Survey. Denver, CO.

Brett, C.E., W.M. Goodman, S.T. LoDuca, and D. Tetreault. 1999. *Silurian-Early Devonian Sequence Stratigraphy, Events, and Paleoevnironments of western New York and Ontario, Canada*. Field Trip Guidebook. New York State Geological Association 71st Annual Meeting. Fredonia, NY. B1 – B36.

Broughton, J.G., D.W. Fisher, Y.W. Isachsen, and L.V. Rickard. 1966. Reprinted 1976. *Geology of New York A Short Account*. The University of the State of New York, The State Education Department, New York State Museum and Science Service. Albany, NY.

Bunce, R.G. H. 1968. An ecological study of Ysgolion Duon, a mountain cliff in Snowdonia. J. Ecol. 56: 59-75.

Cooperative State Research, Education, and Extension Service (CSRSEE), USDA. 2008. "Family Farm Forum." April 2008. http://www.nifa.usda.gov/nea/ag_systems/pdfs/farm_transitions_update.pdf. Accessed April 2014.

Cornell Cooperative Extension. n.d.[a]. *Niagara County Agriculture.* Website: http://www.cceniagaracounty.org/program-areas/agriculture/niagara-county-agriculture/. Accessed August 23, 2013.

_____. n.d.[b]. New York Invasive Species Information. http://www.nyis.info/. Accessed September 2013.

Cowardin, L. M., V. Carter, F. C. Golet, E. T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C. Jamestown, ND: Northern Prairie Wildlife Research Center Online. http://www.npwrc.usgs.gov/resource/wetlands/classwet/index.htm (Version 04DEC1998).

eBird. 2013. eBird: An online database of bird distribution and abundance [web application]. eBird, Ithaca, New York. http://www.ebird.org. Accessed September 11, 2013.

Eckel, Patricia. 2004. "Notes on the Limits of Sacred Precinct on Scovell's Knoll (Oak Hill), Lewiston, Niagara County, New York." http://www.mobot.org/plantscience/resbot/niag/scovknoll/scovknoll.htm. Accessed: August 23, 2013

Ecoregions of New York State – S.A. Bryce, G.E. Griffith, J.M. Omernik, G. Edinger, S. Indrick, O. Vargas, and D. Carlson. June 2010. (Color poster with map, descriptive text, summary tables, and photographs): Reston Virginia, U.S. Geological Survey.

Esseks, J., Shchiling, B., and Hahn, A. 2013. "Impacts of the Federal Farm and Ranchland Protection Program: An assessment Based on Interviews with Participating Landowners." American Farmland Trust and the Center for Great Plains Studies, University of Nebraska – Lincoln. http://www.farmlandinfo.org/FRPPImpacts. Accessed January 2014.

Evans, Chris. [n.d.] Illinois Wildlife Action Plan: Reed Canary Grass (photo). University of Georgia. Accessed 5 November 2013. bugwod.org.

Federal Register. Notice of a 90-Day Finding for Eastern Small-footed Bat and Northern Long-eared Bat, Department of the Interior, Fish and Wildlife Service, to be codified at 50 CFR Part 17.

Field & Fork Network. [n.d.] http://fieldandforknetwork.com/. Accessed November 4, 2013.

Frick, W.F., J.F. Pollock, A.C. Hicks, K.E. Langwig, D.S. Reynolds, G.G. Turner, C.M. Butchkoski, and T.H. Kunz. 2010. An emerging disease causes regional population collapse of a common North American bat species. *Science* 329:679-682.

Gibbs, James P., Alvin R. Breisch, Peter K. Ducey, Glenn Johnson, John Behler, and Richard Bothner. February 2007. New York State Amphibian and Reptile Atlas Project. http://www.dec.ny.gov/animals/7485.html. Accessed April 2013.

Hettinger, R.D. 2001. *Subsurface Correlations and Sequence Stratigraphic Interpretations of Lower Silurian Strata in the Appalachian Basin of Northeast Ohio, Southwest New York, and Northwest Pennsylvania*. Pamphlet to Accompany Geologic Investigations Series I-2741. U.S. Geological Survey.

Historical Association of Lewiston, Inc. n.d. History of Lewiston, New York. http://www.historiclewiston.org/history.html. Accessed June 2013.

Horton, John, Edward Williams, and Harry Douglas. 1947. History of Northwestern New York: Erie, Niagara, Wyoming, Genesee, and Orleans Counties. Volume II, Lewis Historic Publishing Company, Inc., New York.

Hoying, S. M. Fargione and T. Robinson. 2008. Fruit Production in New York. ISHS Symposium, August 4-8, 2008, NYSAES, Geneva, NY.

Johnston, Richard H. 1964. *Ground Water in the Niagara Falls Area, New York with Emphasis on the Water-Bearing Characteristics of the Bedrock.* Bulletin GW-53, New York State Water Resources Commission, Albany, New York.

Kilgour, W.J. 1966. *Middle Silurian Clinton Relationships of western New York and Ontario*. Geology of western New York Guide Book, edited by E.J. Buehler. New York State Geological Association 38th Annual Meeting. Buffalo, NY. 10 – 18.

Kuntz, Kathryn Lynne and Douglas W. Larson. 11 January 2006. Microtopographic control of vascular plant, bryophyte and lichen communities on cliff faces. *Plant Ecology (2006).*

Larson, D. W., S.W. Spring, U. Matthes-Sears, and R.M. Bartlett. 1989. Organization of the Niagara Escarpment cliff community. The Canadian Journal of Botany 67: 2731-2742.

Lewis, Clarence. 1959. "Bones of mastodon, Mammoth, Found in Area, Records Show." *Union-Sun Journal*, Lockport, NY July 15, 1959.

_____. 1968. "Old Story Recalls Discover." *Union-Sun and Journal*, Lockport, NY. September 18, 1968.

Lewiston, Village of, 2011. Village of Lewiston Board Meeting – Monday, October 3, 2011

Lowery, Archie. "Famed Indian Watering Place Saved for Posterity Believed One of the World's Smallest Public Plots." Buffalo News. April 13, 1963.

Lutzenhiser, M. and N.R. Netusil. 2001. The Effect of Open Space on a Home's Sale Price. Contemporary Economic Policy **19**(3): 291-298.

Maloni, J. 2011. *WNY Land Conservancy protects first site on Niagara Escarpment*. Niagara Frontier Publications. http://www.wnypapers.com/news/article/current/2011/11/04/104238/wny-land-conservancy-protects-first-site-on-niagara-escarpment. Accessed August 23, 2013.

McGowan, Kevin J. and Kimberley Corwin. December 2008. *The Second Atlas of Breeding Birds in New York State.* Cornell University Press.

Mohlenbrock, R.H. 1989. "Midwest Wetland Flora: Field Office Illustrated Guide to Plant Species." Midwest National Technical Center, Lincoln, NB.

Morgan, D.E., and A.J.K. Calhoun. 2012. The Maine Municipal Guide to Mapping and Conserving Vernal Pools. University of Maine, Sustainability Solutions Initiative, Orono, ME.

Morganstein, Martin and Cregg, Joan. 2001. "Images of America: Erie Canal." Erie Canal Museum. Arcadia Publishing, Charleston, South Carolina.

National Audubon Society, Inc. 2013a. National Audubon Society Birds. http://birds.audubon.org/. Accessed August 12, 2013.

National Audubon Society, Inc. 2013b. The 2007 Audubon WatchList. Accessed 26 September 2013. http://birds.audubon.org/2007-audubon-watchlist.

National Park Service, Erie Canalway National Heritage Corridor, New York; www.nps.gov/erie and www.eriecanalway.org

National Park Service Digital Library. 2013. National Register of Historic Places, Niagara County, New York. Accessed 4 November 2013. http://nrhp.focus.nps.gov/natreghome.do

New York Natural Heritage Program (NYNHP). 2002. *Ecological Communities of New York State*. Second Edition. Edited by G.J. Edinger, D.J. Evans, S. Gebauer, T.G. Howard, D.M. Hunt, and A.M. Olivero. A revised and expanded edition of Carol Reschke's Ecological Communities of New York State. (Draft for review). New York Natural Heritage Program, New York State Department of Environmental Conservation, Albany, NY.

_____. 2010. New York Rare Plant Status Lists June 2010. Edited by Stephen M. Young. http://www.dec.ny.gov/docs/fish_marine_pdf/2010rareplantstatus.pdf. Accessed April 2014.

_____. 2012. New York Natural Heritage Program Plant Guides. http://www.acris.nynhp.org/plants.php. Accessed September 2013.

New York Sea Grant. 2011. New York Invasive Species Information - New York Invasive Species Clearinghouse. http://nyis.info/.

New York State Department of Environmental Conservation (NYSDEC). 2013a. Species of Greatest Conservation Need. Accessed 26 September 2013. http://www.dec.ny.gov/animals/9406.html.

_____. 2013b. Environmental Resource Mapper. Accessed 30 October 2013. http://www.dec.ny.gov/imsmaps/ERM/viewer.htm.

_____. 2013c. Wild, Scenic and Recreational Rivers. Accessed 4 November 2013. Available online http://www.dec.ny.gov/lands/32739.html

_____. 2013d. Protection of Waters Program. Accessed 4 November 2013. http://www.dec.ny.gov/permits/6042.html

_____. 2013e. Downloadable Mining Database website. Accessed September 2013. http://www.dec.ny.gov/lands/5374.html

_____. 2013f. List of Endangered, Threatened and Special Concern Fish and Wildlife Species of New York State. http://www.dec.ny.gov/animals/7494.html. Accessed September 28, 2013.

_____. 2012. *DEC Reports: 2012 Winter Bat Survey Results.* [Press Release April 19, 2012] http://www.dec.ny.gov/press/81767.html

_____. September 2005. *Comprehensive Wildlife Conservation Strategy for New York.* http://www.dec.ny.gov/animals/30483.html.

_____. 2000-2005 [updated 11 June 2007]. New York State Breeding Bird Atlas [website]. Accessed 11 September 2013. http://www.dec.ny.gov/cfmx/extapps/bba/##.

_____. 2010. Division of Water Assessment and Monitoring. Water Quality Classifications for New York State. Albany, New York.

_____. 2008. Geodata Inventory: Environmental Remediation Sites. Accessed September 2013. Available online http://www.dec.ny.gov/geodata/DiscoveryServlet

New York State Office of the Comptroller. 2010. "Economic Benefits of Open Space Preservation." Albany, NY.

New York State Office of Parks, Recreation and Historic Preservation (OPRHP). December 2010. New York Statewide Trails Plan. http://nysparks.com/recreation/trails/documents/StatewideTrailsPlan/StatewideTrailsPlanExecutiveSummary.pdf

_____. 2009. "Statewide Comprehensive Outdoor Recreation Plan 2009-2013." Albany, NY.

_____. 2007. "General Public Recreation Survey, 2004. Albany, NY.

New York State Office of Tax and Finance. 2012. Property Class Codes: Niagara County Real Property Tax Services. Niagara County, New York.

Niagara County. 2013a. *Bond Lake County Park.* http://www.niagaracounty.com/parks/BondLakePark.aspx. Accessed August 23, 2013.

_____. 2013b. *Royalton Ravine Park*. Website: http://www.niagaracounty.com/parks/RoyaltonRavinePark.aspx. Accessed August 23, 2013.

_____. 2009. Niagara Communities Comprehensive Plan 2030: A Plan to Communicate, Collaborate and Connect. Niagara County, NY. July 2009. http://www.niagaracounty.com/Portals/0/docs/NCCompPlan/Final_NiagCommCompPlan.pdf. Accessed November 1, 2013.

Niagara County Department of Economic Development. 2013. *Comprehensive Economic Development Strategy*.http://www.niagaracountybusiness.com/2013_Niagara_County_CEDS.pdf

Niagara County Historical Society. 2012. Erie Canal Discovery Center, Lockport. www.NiagaraHistory.org

Niagara Frontier Wildlife Habitat Council. n.d. *Gulf Wilderness Park*. Website: http://www.nfwhc.org/parks/gulf.htm. Accessed August 23, 2013.

Niagara River Greenway Commission. April 4, 2007. Niagara River Greenway Plan and Final Environmental Impact Statement. http://www.niagaragreenway.org/sites/all/themes/nrgc/FINAL%20REPORT.pdf

Omernik, J.M., 1995, Ecoregions - a framework for environmental management, in Davis, W.S. and Simon, T.P., eds., Biological assessment and criteria-tools for water resource planning and decision making: Boca Raton, Florida, Lewis Publishers, p. 49-62.

Parks & Trails New York. [n.d.]. Health Trails, Healthy People. Accessed 4 December 2013. http://www.ptny.org/greenways/hthp/projects.shtml

Peca, Paulette. 2003. "Images of America – Lockport"

Sauer, J.R., J.E. Hines, J.E. Fallon, K.L. Pardieck, D.J. Ziolkowski, Jr., and W.A. Link. 2012. *The North American Breeding Bird Survey, Results and Analysis 1966-2011. Version 07.03.2013*. USGS Patuxent Wildlife Research Center. Accessed 11 September 2013. http://www.mbr-pwrc.usgs.gov/bbs/bbs.html.

Shibley, Robert G. and Hovey, Bradshaw. 2003. "Public Choices and the Dynamics of Sprawl. The Urban Design Project, University at Buffalo, State University of New York

Southwick Associates. 2012. "The Outdoor Recreation Economy." Outdoor Industry Association.

Smith, Mark. 2010. Town of Lockport, Lytle Nature Preserve Project. http://www.niagaragreenway.org/sites/default/files/Lytle%20Nature%201.pdf

Stegemann, Eileen, and Alan Hicks. 2008. "Bats of New York." *New York State Conservationist*. February 2008: Volume 64, Number 4. Print.

Tesmer, I.H. (ed.). 1981. *Colossal Cataract The Geologic History of Niagara Falls*. Albany, NY. State University of New York Press.

The Trust for Public Land. 2012. "The Economic Benefits of New York's Environmental Protection Fund." New York, NY. http://cloud.tpl.org/pubs/local-ny-economic-benefits-rpt2012.pdf. Accessed January 2014.

Town of Lockport. Undated. Nature Trail Map. http://elockport.com/town-parks-trail-map.php. Accessed 23 August 2013.

United States Census Bureau. 2011. DP05, ACS Demographic and Housing Estimates. Geographies: Tuscarora Nation Reservation, Niagara County, New York. 2007-2011 American Community Survey 5-Year Estimates. http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_11_5YR_DP05&prodType=table. Accessed October 30, 2013.

United States Department of Agriculture (USDA). 2007. Census of Agriculture – Niagara County, NY. http://www.agcensus.usda.gov/Publications/2007/Online_Highlights/County_Profiles/New_York/cp36063.pdf. Accessed January 2014.

_____. 2012. Preliminary 2012 Census of Agriculture – Preliminary Report. http://www.agcensus.usda.gov/Publications/2012/Preliminary_Report/Full_Report.pdf. Accessed April 2014.

USDA Soil Conservation Service. 1972. *Soil Survey of Niagara County, New York*. In Cooperation with the Cornell University Agricultural Experiment Station.

USDA Natural Resources Conservation Service (NRCS). 2010. Soil Survey Geographic (SSURGO) Database for New York. February 2010. htpp://soildatamart.nrcs.usda.gov Accessed June 2013.

_____, 2014. The PLANTS Database. National Plant Data Team. Greensboro, NC 27401-4901. http://plants.usda.gov

_____. [n.d.]. Fact Sheets & Plant Guides, Purple Loosestrife. Accessed September 2013. http://plants.usda.gov/core/profile?symbol=lysa2

United States Environmental Protection Agency (EPA). June 25, 2012. Yellow giant hyssop (image) http://www.epa.gov/glnpo/image/viz_native 4.html

_____May 29, 2013a. Eighteenmile Creek, New York, EPA ID#NYN000206456 NPL Listing History. http://www.epa.gov/region2/superfund/npl/0206456c.pdf. Accessed September 11, 2013.

_____. Last updated June 4, 2013b. Great Lakes Areas of Concern: Eighteenmile Creek River. http://www.epa.gov/greatlakes/aoc/eighteen/. Accessed September 11, 2013.

_____. Last updated June 21, 2013c. My WATERS Mapper. http://watersgeo.epa.gov/mwm/. Accessed 9 April 2014.

United States Fish and Wildlife Service (USFWS). 2013a. White-nose syndrome.org, North America's response to the devastating bat disease. http://whitenosesyndrome.org/. Accessed August 27, 2013.

United States Fish and Wildlife Service. July 16, 2012. *Federally Listed Endangered and Threatened Species and Candidate Species in New York (by county).* Accessed 4 October 2013. http://www.fws.gov/northeast/nyfo/es/colistcurrent.pdf

United States Fish and Wildlife Service. 2002. National Wetlands Inventory website. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C. Accessed June 2013. http://www.fws.gov/wetlands/.

United States Geological Survey (USGS). 1999. *Ground Water, U.S. Geological Survey General Interest Publication, Reston, Virginia, 1999 revision.* Website*:* http://capp.water.usgs.gov/GIP/gw_gip/index.html. Accessed August 27, 2013.

_____. 2001. National Gap Analysis Land Cover Data – Version 2. US Geological Survey.

_____. 2013. Mineral Resources Data System (MRDS). Last revised: February 5, 2013. http://mrdata.usgs.gov/mineral-resources/mrds-us.html. Accessed March 22, 2013.

Western New York Regional Economic Development Council. 2011. "A Strategy for Prosperity in Western New York." 2011. http://regionalcouncils.ny.gov/themes/nyopenrc/rc-files/westernny/FINALPLAN.pdf. Accessed January 2014.

Wooster, Margaret. 2009. "Living Waters – Reading the Rivers of the Lower Great Lakes." State University of New York. Albany, New York.

9 Glossary

Alvar: an ecological environment existing on a flat limestone plain with little or no soil.

Alvar shrubland: an ecological community type containing more than 25% cover by shrubs on limestone pavement and characterized by large crevices between limestone boulders where plants are rooted. It also contains areas of exposed limestone covered by mosses, bryophytes and lichens.

Alvar woodland: a subset of the limestone woodland community type restricted to the alvar region in Jefferson County, New York. They may be a later successional stage of the alvar shrublands.

Bedrock: a deposit of solid rock that is typically buried beneath soil and other broken or unconsolidated material.

Calcareous talus slope woodland: an ecological community type consisting of talus gradients of calcareous (limestone or dolomite) bedrock and moist, loamy soil with either an open or closed canopy.

Cuesta: a gently sloping hill or ridge

Ecological community: a group of two or more potentially interacting species that occupy a common environment.

Floodplain forest: a hardwood forest on mineral soils on low terraces of river floodplains and river deltas. Low areas are flooded regularly, particularly in the springtime after ice melt; higher areas are flooded more irregularly.

Haudenosaunee Confederacy: "People of the Longhouse;" known previously as the Iroquois Confederacy or the League of Five Nations, which is composed of the Mohawk, Oneida, Onondaga, Cayuga, Seneca, and Tuscarora Nations.

Hydric soil: a type of soil that is formed in areas saturated with water long enough during the growing season to develop anaerobic conditions.

Limestone: sedimentary rock composed of calcium carbonate ($CaCO_3$) often formed from shell fragments of marine organisms.

Limestone woodlands: an ecological community type consisting of a low-density forest in shallow soils over limestone bedrock. These communities contain numerous rock outcrops and can have either an open or closed canopy layer.

Maple-basswood rich mesic forest: a hardwood forest occurring on well-drained, moist soils with nearly neutral pH primarily distributed throughout the Great Lakes ecoregion and, as the name implies, dominated by sugar maple, basswood, and white ash species.

Niagara Escarpment: The Escarpment is the steep north face of a bedrock ridge whose sedimentary rock layers were formed from sediments deposited more than 400 million years ago when North America was closer to the equator and partly covered by a shallow sea. The ridge we see today is the result of tectonic uplift, millions of years of erosion, and multiple glaciations.

Shallow emergent marsh: an ecological community type that occurs on mineral soil or deep muck soils (rather than true peat), that is permanently saturated and seasonally flooded. Water depths may range from 6 inches to 3.3 feet (15 centimeters to 1 meter) during flood stages, but the water level usually drops by mid to late summer and the substrate is exposed during an average year. This marsh is better drained than a deep emergent marsh.

Shale: a fine-grained, elastic sedimentary rock composed of mud that is a mix of flakes of clay minerals and silt-sized particles of other minerals, like quartz and calcite. Shale is characterized by breaks along thin laminae or parallel layering.

Soil association: a group of soils that are geographically related and found in a characteristic repeating pattern across a landscape.

Sole source aquifer: an aquifer that supplies at least 50% of the drinking water in the geographic area that overlays the aquifer

Spring: an aquatic community present in very small stream sources where flow is perennial. These streams are short in length, shallow, and are rich in dissolved oxygen.

Talus: a sloping mass of loose rocks.

Talus cave: openings formed between boulders often used as dwelling space for various insects, bats, and mammals.

Vernal pools: ephemeral collections of water that fill with melt water in the spring and can dry out in the summer.

Wetland: an area that is either permanently or seasonally flooded with water and is characterized by emergent hydrophytic vegetation and hydric soils.

Woodland: community consisting of a canopy of stunted or dwarf trees (measuring less than 16 feet [4.9 meters] tall), and wooded communities occurring on shallow soils over bedrock with numerous rock outcrops. Woodlands typically have a more open canopy than forests.